THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1905 Edition

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THE NATIONAL PHYSICAL LABORATORY AND SCIENTIFIC MANUFACTURE.

ONE of the functions of the director of the National Physical Laboratory is to remind us from time to time of our sins of omission; and read between its lines, Dr. Glazebrook's report to the British Association at Cambridge is a pretty severe lecture on our shortcomings. We ourselves are convinced, and even think it cannot be seriously disputed, that the main reason for our failing trade is the defective education of English manufacturers in matters which concern their business; and by those who are in a position to judge, the deficiency is known to be so serious that the comparative success of the country in holding its own can only be looked on as evidence of extraordinary natural ability for business. For many kinds of business, natural aptitude alone is not a sufficient qualification. To the successful conduct of chemical, metallurgical, and electrical work, and of the manufacture of scientific apparatus, a thorough technical education is as necessary as good physical health or a knowledge of English. Capacity for administration, financial judgement, and business aptitude must be found and cannot be imparted, but any capable man can acquire technical knowledge by time and effort, and there should be no question of his admission to an administrative post in large works while that condition is not satisfied. Indifference is worse than ignorance. When Gallio controls the technical operations of other men the result is paralysis. Constant intelligent pressure for economy of process; suggestions of possible departures to meet new business openings; demands for more accurate observation and workmanship; constant information to the workshops of new materials or new designs; these are the life of a great business, and how shall a mere administrator, however eminent, supply them? Where the administrative head of a concern is a pure financier or routine manager, there is a risk that the technical ability of his subordinates will be wasted. Without the sympathetic knowledge of their work, he will not recognise at the bench those natural mechanics who are found in English workshops, or those men of exalted conscience, the old Puritan blood, whose pride is in good work, and pleasure in its recognition. How is he to find the man for his right hand when he is wanted? He pays us a small sum to find one, who too often is made in Germany, and has a value corresponding to our charges for advertisement. The English are of eminent ability in affairs, possibly more eminent than any other race of whom we have historical knowledge, but that ability is wasted to an extravagant extent in several industries by the incompetence of the leaders. We could point to men, factory managers, heads of departments, foremen, who have the ability to govern empires, and yet insufficient knowledge for their daily tasks. What other country can point to such a group of public servants of recognised ability as we possess, drawn from one relatively

small social class? But that class has no natural advantages over the working and trading classes who carry on the commercial industries. Can we not compete with America in making steel, or Germany in chemicals? Certainly we can, but not by training the future leaders of the metallurgists on the cricket field, or of the chemists in the billiard room.

If the general body of men who control the manufacturing industries had been trained to the use of scientific methods, instead of merely having read about them, the Government would not require pressure to put a few thousand pounds into a national investment combining the security of Bank Stock with a return beyond the dreams of Mr. Beit. A great physicist and ardent public servant appeals to public opinion for help in that which we hold to be the one obvious solution of the problem which an egregious Tariff Commission, far from solving, cannot even state.

Third Rail Fatalities.

THE frequent fatal accidents due to the live rails on the Liverpool—Southport and Tyneside electric railways are rousing public opinion on the matter, and it is more than probable that strong opposition will be displayed against the further adoption of the third-rail system, except on underground and overhead railways, in the United Kingdom. It is worthy of note that hardly any accidents of this kind have occurred on the City and South London and the Liverpool Overhead electric railways, although these have been in continuous operation for 14 and 11 years respectively, the reason doubtless being that they are comparatively inaccessible to trespassers. Hence it may be argued that the risk to the railway officials themselves is small in comparison with the dangers due to shunting, &c., and this is of interest in view of the resolution recorded in our "Notes" columns to-day, expressing the alarm of the Amalgamated Society of Railway Servants at the prospect of the extended application of electric traction. Nevertheless, it must be admitted that more than one railway official have already lost their lives on the newer electric lines.

Our views with regard to the third rail have frequently been stated. It may be suitable for suburban railways, which are well fenced against trespassers, and on which the stops are so frequent that the special properties of the direct-current motor are of the first importance; but on interurban and main line railways the third rail is utterly out of place, and there is nothing to compare with the high-pressure alternating-current overhead conductor system.

We note in this connection that Dr. S. P. Thompson has written to the *Times* protesting against the use of the "live rail," which he characterises as "an obsolete device, discarded in the latest types of electric railway," and an "engineering blunder." The Professor goes still further in suggesting that "in 10 years' time there will probably be no 'live rail' left"; and he would even replace the third rail by an overhead conductor in underground railways. We are not prepared to go to these extreme lengths, for it is hardly to be regarded as a "blunder" to use the best device available at the time, and the entirely successful working of our underground and overhead railways must not be ignored. But we welcome Dr. Thompson's support to our main contention as outlined above.

In an interview reported in the *Daily News*, Mr. J. R. Chapman, engineer to the Underground Railway Co., is said to have cited the abandonment of the overhead conductor on the Baltimore and Ohio Railway in favour of the third rail, and on the New York, New Haven and Hartford Railway, as arguments against the use of the overhead system; but these examples are totally irrelevant. No one would for one moment suggest the use of the overhead wire with direct current at 500 or 600 volts for railway working nowadays, as in the cases adduced by Mr. Chapman. As a matter of fact, in no country is the adoption of the high-pressure alternating current overhead system being more rapidly pushed forward than in the United States; and when the Americans, so long the victims of over-standardisation, bestir themselves to take up a totally new system of traction, involving the development of new ideas and designs, it is safe to say that the occasion is most urgent. Nothing contributed more largely to the too prolonged retention of the direct-current system than the fact that the plant thereby necessitated—especially the rotary converters and switchgear—led to a much greater expenditure than was called for by the alternating-current system, and was, therefore, much more profitable to the contractors.

Paraphrasing a famous remark of the German Emperor, we may confidently say that, so far as electric traction is concerned, "Our future lies over the head!"

Journal Boxes

A WRITER in the *Street Railway Review* for August dilates on the loss of energy which occurs owing to defective design and inefficient maintenance of axle boxes on car trucks. He argues that the Master Car Builders' type of truck, on which the axle boxes are connected rigidly by an equaliser bar, is the only properly designed truck from this point of view.

We agree with him that an equalising bar is wanted in order to diminish the wear which now takes place between the sides of the boxes and the horn plates. This wear becomes serious in three years or thereabouts, but although makers have known of it, they have been most reluctant to fit wearing pieces on the horn plates of new trucks. Consequently, small concerns having no machine tools have been put to much expense in fitting them when wear has become already excessive, and larger ones have had their repair shops cumbered with repairs which ought to have been unnecessary. The author is concerned chiefly with the considerable energy loss which may take place when bad fitting and wear combined result in the wheels rubbing hard against the brake shoes. First of all the journal brass may have play in the box, and then the box may be loose in the horn plates. The brakes will be adjusted to a nicety when the car is at rest and the axles are central, but directly the axles are driven the wheels travel out to the full extent of the lost motion, which may be very easily much greater than the clearance given in the sheds between wheels and brakes. Thus one of the motors has to contend against perpetual braking. It would be interesting to hear the experience of British engineers on this point.

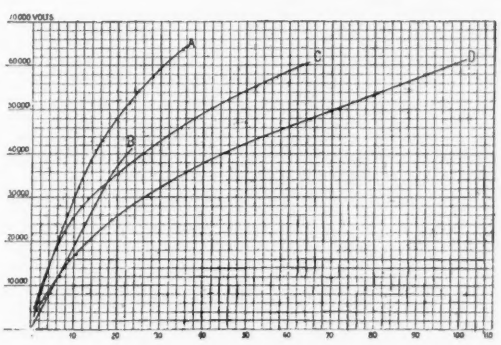
Factory Hours and Load Factor.

THE one-break working day has so many advantages, that the reasons for sticking to the old two-break day must be sought in the conservatism of the masters and the opposition of the men. Certainly the men do object to any alteration of their immemorial hours, but they object, as a rule, to everything savouring of novelty, and in this particular instance, as well as in many others, they settle down to the altered conditions within a period which varies with the degree of firmness used to execute the change, so much so that they would refuse to return to the two-break day just as heartily as they objected to give it up. While power-station engineers may not consider that either arrangement matters to them outside their own fitting shop if they have one, they would do well to become enthusiasts on the subject, for the universal adoption of the one-break day would have an appreciably beneficial effect on the load factor of their stations. This applies more particularly to stations having a good motor load, but in a few years all will have that. Even if the breakfast "hour" is only 30 minutes, the deep valley in the load curve between 8.30 a.m. and 9 a.m. is to be deplored. Sometimes it is hardly worth while shutting down and starting up again the corresponding portion of the plant, especially when this would mean changing over from a large to a smaller set, so the station goes on running as before, but at a poor load factor. The financial results of the station would be improved, and the engineer's lot would be lightened, if all factories ran from 7 to 12, and from 1 to 6, or hours such as these.

DIRECT CURRENT TRANSMISSION AT 70,000 VOLTS.

By A. STEENS.

The Compagnie de l'Industrie Electrique et Mécanique, of Geneva, recently carried out a number of interesting experiments with direct current at 70,000 volts, with a view to ascertaining the extent to which insulators would withstand the direct current as compared with alternating current. As many practical data are now available with regard to the latter, it was interesting to establish, as far as possible, the ratio existing between the two kinds of current, so as to determine the values of the D.C. pressures equivalent to A.C. pressures, and consequently to what distances one could transmit electrical energy on the two systems respectively, with equal losses and reliability of service.



Millimetres.

A, Ball and ball; B, Point −, plate +; C, Plate +, ball −, and plate −, ball +; D, Point +, plate −.

Fig. 1.—Curves of Sparking Distance with Direct Current.

For this purpose, three dynamos were coupled in series, of which one could easily give 20,000 volts, and each of the others 25,000 volts, so that a total D.C. pressure of 70,000 volts was available. Each of the generators could generate current up to 1 ampere, giving a total power of 60 to 70 KW., which was more than sufficient for the purpose of the experiments. The trials have an important bearing upon the transmission of electrical energy, which is being so rapidly applied to modern industries; for as the more favourably situated waterfalls are successively utilised, the more remote must be brought into use, and the transmission becomes increasingly difficult.

Thus, in Switzerland, the city of Zürich is considering the question of supplying its wants by drawing upon natural sources distant more than 130 km. from the centre of utilisation; and in France serious proposals have been made to supply Paris with power from sources more than 400 km. from the capital.

In Egypt, again, about 30,000 H.P. is furnished by steam plant for the agricultural needs of the Delta of the Nile, and this amount is far from sufficient. In place of consuming an enormous quantity of coal for this purpose, the almost unlimited resources of the Upper Nile, at present running to waste, might be made use of, were not the distance so great that pressures of magnitudes as yet untried would have to be employed, in order to keep down the cost of the line to a reasonable value.

To illustrate this point, we may mention that with direct current, allowing a loss of 10 per cent. in the line, and a weight of copper equal to 30 kg. per electrical horse-power delivered, it would be necessary to employ an initial pressure of 4,200 volts for 10 km., 42,000 volts for 100 km., and no less than 420,000 volts for 1,000 km.! The use of the earth as return conductor, which has been suggested in some quarters, would double these distances, or halve the pressures, as preferred; on the other hand, the use of alternating currents would reduce them, not only on account of the less efficient use of the lines entailed thereby, but also because of the secondary phenomena connected with capacity and inductance, which increase the losses in the line. The foregoing figures, it will be understood, are merely illustrative; in practice, it would be more economical to allow a greater loss in the line at the greater distances.

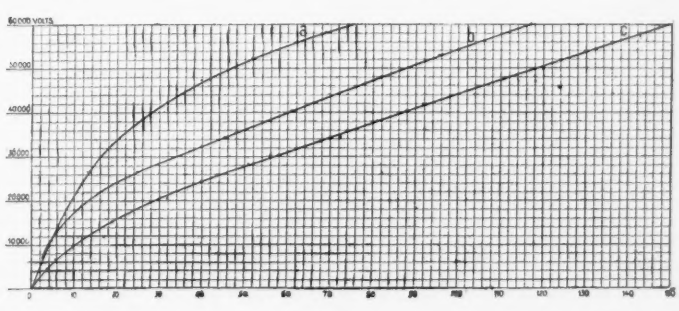
The highest D.C. pressure hitherto employed did not exceed 25,000 volts, and therefore an untrodden field lay before the experimenters, with the possibility of totally unlooked-for results being obtained, and limits discovered beyond which it was impossible to go.

For comparative purposes an alternating current was employed, generated by an alternator specially selected for this purpose, it having been found in the course of preliminary experiments that the alternating current supply obtainable from the mains in Geneva gave very variable results. This trouble was due to the irregular wave form of the mains pressure, which is the resultant derived from three different types of machines running in parallel; its deformations are also aggravated by the irregular running of numerous A.C. motors of various types, and to a considerable extent by the capacity of the network of mains. The alternating current was regulated by means of the exciting current and by changing the connections of the step-up transformer. The direct current was regulated by varying the number of machines in series, and by adjusting their excitation.

The direct current could not be considered perfectly uniform, on account of the small number of commutator segments (96) and of the winding of the armature coils on a toothed core, but the deviation was not very appreciable.

The alternator employed for the tests had a rotating armature and a stationary six-pole field, the output being 75 KW.; the speed was kept constant at 1,000 r.p.m., giving a frequency of 50 cycles per second. The armature core was a smooth drum, with 12 coils bound on the surface by bands of German silver. The field poles embraced two-thirds of the circumference, and the armature coils occupied rather less than half the circumference of the drum, in the ratio of 1 : 1·1.

In spite of these conditions, favourable to the A.C. and unfavourable to the D.C. system, the results obtained were distinctly in favour of the latter. All the insulators, without exception, resisted much higher pressures with direct current than with alternating current, as was to be expected.



Millimetres.

a, Ball and ball; *b*, Plate and ball; *c*, Plate and point.

Fig. 2.—Curves of Sparking Distance with Alternating Current.

The same is true of the insulating materials subjected to perforation, whilst no heating of the insulator was observed in the case of the D.C. tests. This was not the case with alternating current, the difference being mainly due to capacity effects, which were absent when D.C. was used. The porcelain insulators used, were fitted with their ordinary iron stems.

For the sparking distance with direct current, the various results depend upon the nature of the electrodes employed and their polarity. Four curves were obtained with the arrangements which gave the most uniform results (fig. 1) The spark between points was very variable, and the results were valueless. The polarity has a marked influence when the sparks pass between a point and a plate; whilst at 40,000

volts with the point negative the sparking distance is 22 mm., with the point positive the distance for the same pressure is increased to 44 mm., just double. The smallest distances were obtained between metal spheres 20 mm. in diameter—say, 31 mm. in length at 60,000 volts—and the greatest were between a positive point and a negative plate, about 99 mm., with the same pressure, or three times as great a distance as in the former case.

With A.C. at 50 cycles per second, the same difference between the curves is found (fig. 2); one shows the spark striking between balls, at a distance not greater than 74 mm. at 60,000 volts, while another shows breakdown at the same pressure at 149 mm. between point and plate. The mean ratios of the sparking distances, D.C. to A.C., are respectively as follows :—

	At 30,000 volts.	At 60,000 volts.
Ball and ball	1·6	2·5
Plate and ball	2·4	1 85
Point and ball	2·2	1·51

The E.M.F. curve of the A.C. generator, fig. 3, shows that the maximum pressure is only 1·255 times the effective pressure; the greater ratios given above are partly due to the fact that

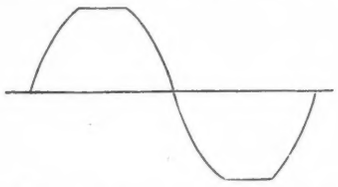


Fig. 3.—E.M.F. Wave Form of Alternator Employed.

the sparking distance increases more rapidly than the corresponding pressure. This ratio is much higher when the central station supply is used, owing to the deformations of the latter.

These observations having been made, porcelain insulators of ordinary types (fig. 4) were subjected alternately to D.C. and A.C. pressures, gradually increasing, until a short-circuit was set up between the line wire and the iron stem, which was always connected directly with one of the poles of the generator used. The trials formed two distinct series—one in the laboratory, with dry and clean insulators, the other out of doors, on insulators exposed to the weather for a certain

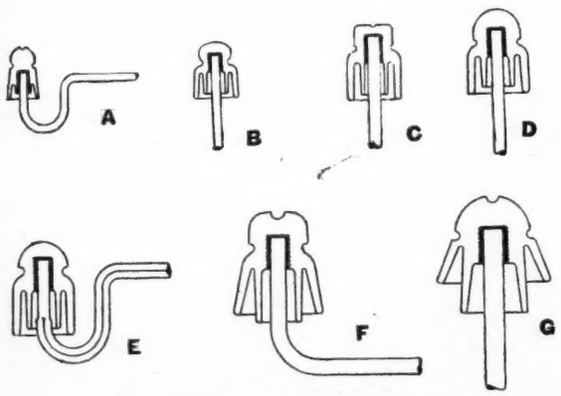


Fig. 4.—Types of Insulator Tested.

time. Advantage was taken of a day of continuous rain to carry out tests upon insulators quite wet. As will be seen, the difference is very great. The number of insulators tested together was too small to admit of the power expended being measured; the only indication was the slight heating observed with A.C. at high pressures.

The results were as follows :—

Breakdown pressures.	In the laboratory. A.C.	In the rain. A.C.	In the rain. D.C.
Type A.	25,000	15,000	24,000
„ B.	42,000	21,400	34,000
„ C.	50,000	27,000	40,000
„ D.	54,000	34,700	45,300
„ E.	34,000	31,160	40,800

The large double-petticoat insulators, F and G, did not yield at 60,000 volts. A very small number of the smaller models were perforated, but generally the spark jumped over the outside, between the binding wire and the pin. In the latter cases one could apply successively D.C. and A.C. to the same insulator. Insulators pierced by the A.C. trial could still withstand very great D.C. pressures in the laboratory, but in the rain the limit pressures were naturally lowered to nearly half.

There was no appreciable crackling with D.C. when approaching the ultimate pressure that the insulator could withstand, but with A.C. there was often a good deal of noise; moreover, glows and brushes were hardly visible on the conductors until the limiting pressure was approached. Between wires about 50 cm. apart nothing was seen, even at more than 60,000 volts D.C. Sharp points, however, gave slight brushes, which prepared the way for the spark to strike, but the discharge was so irregular that it was not possible to trace a curve for the sparking distance between points, the variations attaining differences up to 300 per cent.

Even at 65,000 volts D.C. it was not possible to pierce simple insulators such as those used in telegraphy, and of the ordinary type used for some years past in certain transmissions of power at moderate pressure. It was found that if the porcelain is well glazed and homogeneous, the thickness matters little. It is sufficient that the striking distance be observed, and as this distance is smaller with the direct current, much higher D.C. pressures are required to bring about breakdown of the insulation.

Afterwards a number of insulating substances were tested for perforation. First a sheet was tested with alternating current, with the following results :—

Time of electrification.		Pressure.	Result.
1st test	90 sec.	9,000 volts	—
	30 „	11,000 „	Spark passed.
2nd test	120 „	9,000 „	Strong brushes.
	15 sec. later	9,000 „	Spark passed.

The same sheet subjected to direct current gave the following results :—

120 sec.	10,000 volts	—
120 „	15,000 „	—
120 „	18,000 „	—
120 „	20,000 „	—
240 „	25,000 „	Spark passed.

Thus this specimen, twice pierced by alternating current after, on the average, 2 minutes' application of 10,000 volts A.C., was able to withstand during 12 minutes, a mean pressure of more than 15,000 volts, and only gave way after the application of 25,000 volts D.C. for 4 minutes. Afterwards a sheet of white marble 20 mm. thick was tried. The specimen was perforated after 75 seconds' application of 20,000 volts A.C. A second test led to perforation after 2 minutes with 15,000 volts A.C.

Perforation with direct current was only accomplished after 15 minutes' application, at pressures from 10,000 to 45,000 volts, the pressure being raised 5,000 volts once every 2 minutes. Already weakened by the preceding experiment with A.C., the specimen showed light brushes from 10,000 volts, increasing up to 45,000 volts, a critical point. This test shows very clearly, like the former, how much better the insulating materials resist D.C. than A.C. pressures. All the substances afterwards tested gave analogous results. At perforation, the D.C. pressures required are always more than double the A.C. pressures and when capacity plays an important part, the difference is still more noticeable.

Glass is very difficult to pierce with D.C. Ordinary white glass of 0·3 mm. resists 25,000 volts very well, and is only pierced when one provokes an oscillating discharge by means of a condenser; a sheet of window glass resists 60,000 volts D.C., and probably more still.

This shows that the difficulties connected with the industrial use of electric currents at high pressures are much less with D.C. than with A.C., a result which had been anticipated. It is thus much easier to insulate not only the transmission line, but also the generators, motors, and all other apparatus connected with the high-pressure D.C. circuits.

The direct current is reproached with the ease with which it electrolyses certain insulators, and gradually weakens them by forming a metallic bridge, which eventually completely penetrates and destroys them. But practice long ago

showed that this cannot take place unless there is moisture in the insulating material. Now, it is not necessary to use such substances, for one has at hand materials of the best quality, such as glass, porcelain, mica, &c., which enable one to entirely exclude the possibility of electrolysis. Thanks to the heat disengaged within them, dynamos, motors, &c., rapidly part with the slight moisture absorbed whilst at rest or in store, a fact which explains why electrolysis, as is well known, is not experienced in such apparatus if they are kept reasonably dry.

In conclusion, the experiments recently carried out at Sécheron have fully confirmed the expectations founded upon the trial of transmission of power between St. Maurice and Lausanne (60 km., 5,000 H.P., at 22,000 volts D.C.). The loss through defective insulation, even in stormy weather, had proved to be practically nil at 20,000 volts (0·02 watt per insulator) and it was anticipated that one could enormously increase this pressure before the loss in the line (by leakage through the insulators and through the air) became appreciable. It seems that the limiting pressure which must not be exceeded with the apparatus at present available, is for D.C. well above 70,000 volts between line and earth. Shielded from the weather (in the laboratory), all the insulators tested withstood a pressure averaging 1·6 times the pressure to which the same insulators yielded out of doors, after 24 hours of fine rain. This justifies the use of the modern multiple petticoat insulators, well splayed out, which give rise to no appreciable leakage, even when damp.

The direct current then permits of reaching, commercially and very economically, distances more than double those hitherto barely reached with polyphase currents; that is to say, that with D.C. one can now pass over 335 km. (210 miles) with 10 per cent. loss only, and 30 kg. of copper per H.P. transmitted; and 1,000 km. (625 miles) with the same weight of copper and a little less than 30 per cent. loss in the line.

From this, the great importance of such experiments will be understood, especially when one remembers that the Swiss, for example, in spite of the small area of their country, expend annually for the coal imported for their locomotives more than half a million sterling, whilst their natural sources of power would without doubt enable them to retain the whole of this amount—and more—within their borders, if it were possible to transmit energy far enough by electricity.

THE FIFTH INTERNATIONAL ELECTRICAL CONGRESS.

By R. BORLASE MATTHEWS, WH. EX.

THIS Congress met at St. Louis during the week, September 12th to 17th. In June, 1903, the President of the St. Louis Exposition appointed an Organisation Committee, in response to whose invitations to join the Congress over 2,100 acceptances were received, about 500 of these being from gentlemen non-resident in the United States. This membership is more than double that of the fourth congress, which was held at Paris, and nearly four times that of the third congress, held at Chicago. Some 600 members attended the meetings, including the visitors from the British Institution of Electrical Engineers and the Associazione Elettrotecnica Italiana, who were taking part in the special tour arranged by the American Institute of Electrical Engineers.

In response to invitations by the Government of the United States, foreign governments sent official representatives to the Chamber of Delegates of the Congress as follows:—

Argentine Republic—Dr. Jorge Newbery.
Austro-Hungary—Prof. Charles Zipernowsky.
Australian Colonies—Mr. John Hesketh.
Canada—Mr. Ormond Higman.
Denmark and Sweden—Prof. Svante Arrhenius
France—M. Poincare, M. Guillebot de Nerville, M. Paul Janet, M. Ferrie, M. Dennery.
Germany—Kaiserlich Postrat Litzrodt.
Great Britain—Col. R. E. Crompton, Dr. R. T. Glazebrook, F.R.S, Prof. John Perry, F.R.S
Hungary—Messrs. Joseph Vater and Bela Gati.
Italy—Prof Moise Ascoli, Prof. L. Lombardi, Ing. A. Maffezzini and Marquis Luigi Solari.
India—Mr J. C. Shields.
Mexico—Senor Rafael P. Arizpe.
Spain—Miguel Otamenti, C E.; Antonio Gonzalez, C.E.
Switzerland—Prof. Ferdinand Weber.

The representatives of the United States to the Chamber of Delegates were:—Prof. H. S. Carhart, Dr. A. E. Kennelly, Prof. H. J. Ryan, Prof. S. W. Stratton, and Prof. Elihu Thomson.

The following bodies, upon invitation, appointed delegates to the Congress, as below:—

The Royal Society—Dr. R. T. Glazebrook, Prof. John Perry.
The Institution of Electrical Engineers—Mr. R. Kaye Gray, Pres.; Col. R. E. B. Crompton, C.B.; Prof. John Perry, F.R.S.; Dr. R. T. Glazebrook, F.R.S.; Mr. H. E. Harrison, B.Sc, B.A.; Mr. W. Duddell, Honorary Secretary of Delegation.
La Societe Internationale des Electriciens—Prof. J. A. Bergonie, M. Marius Latour.
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American Institute of Electrical Engineers—Mr. Ralph D. Mershon, Prof. M. I Pupin, Prof. C. P. Steinmetz.
American Physical Society—Prof. A. G. Webster, Pres.; Dr. Carl Barus, Prof. D. B. Brace.
American Electro-Chemical Society—Prof. W. D. Bancroft; Prof. H. S. Carhart, Pres.; Dr. Louis Kahlenberg.
National Electric Light Association—Mr. Geo. Eastman, Mr. G. Ross Green, Dr. F. A. C Perrine.
Association of Edison Illuminating Companies—Mr. W. C. L. Eglin, Mr. L. A. Ferguson, Mr. Gerhard Goettling.
International Association of Municipal Electricians—Mr. W. H. Bradt, Mr. F. C. Mason, Mr. Walter M. Petty.
Pacific Coast Electric Transmission Association—Prof. F. G. Baum, Dr. F. A. C. Perrine.
American Electro-Therapeutic Association—Dr. Russell Herbert Boggs, Dr. Charles R. Dickson, Dr. W. J. Herdman.
North-Western Electrical Association—T. F. Grover, Pres.; William Goltz.
The United States War Department—Major Samuel Reber, U.S.A.
The United States Navy Department—Lieut.-Commander Joseph L. Jayne, U.S.N.

The number of papers which had been prepared to be read before this Fifth International Electrical Congress were so many that it was found necessary to divide them into sections. There were eight sections ranging from A to H, and the following will give in detail the subjects dealt with in each section, the chairmen, the secretaries, the authors of the papers, and their subjects:—

SECTION A.—GENERAL THEORY—MATHEMATICAL, EXPERIMENTAL.

Chairman, Prof. EDWARD L. NICHOLS.

Secretary, Prof. HOWARD T. BARNES.

Prof. Dr. S. Arrhenius	Electric Charge of the Sun.
Prof. Dr. S. Moise Ascoli	Systems of Electric Units (A. E. Ital. paper).
Prof. Dr. Paul Drude	Electric Conduction in Metals, from Standpoint of Electronic Theory.
Prof. Dr. W. Jaeger	Electrical Standards.
Prof. H. Nagaoka	Magnetostriction.
Prof. J. S. Townsend	Theory of Ionisation by Collision.
Prof. J. J. Thomson	The Corpuscular Theory.
M. J. Violle	Secondary Standards of Light.
Prof. C. T. R. Wilson, F.R.S.	Condensation Nuclei.
Prof. P. Zeeman	Recent Progress in Magneto-Optics.
Dr. Carl Barus	Atmospheric Nuclei (A. Phys. S. paper).
Prof. Howard T. Barnes	Mechanical Equivalent of Heat Measured by Electrical Means. (Roy. Soc., Canada, paper).
Dr. L. A. Bauer	State of our Knowledge on Earth's Magnetism and recent Remarkable Magnetic Storms.
Prof. D. B. Brace	Magneto-Optics (A. Phys. S. paper).
Prof. H. S. Carhart and Prof. G. W. Patterson, jun.	Absolute Value of E.M.F. of Clark and Weston Cells.
Prof. C. D. Child	The Electric Arc.
Dr. K. E. Guthe	Coherer Action.
Dr. A. E. Kennelly	Alternating Current Theory of Transmission Speed over Submarine Telegraph Cables.
Prof. E. Percival Lewis	Electrical Conductivity of Gases.
Prof. J. C. McLennan	Radioactivity of Mineral Oils and Natural Gases.
Prof. Louis T. More	Electrostriction.
Prof. E. F. Nichols	Unobtained Wave-Lengths between Longest Thermal and Shortest Electric Waves yet Measured.
Prof. E. L. Nichols	Standards of Light.
Dr. H. Pender	Magnetic Effect of Moving Charges.
Prof. M. I. Pupin	Electrical Impulses and Multiple Oscillators. (A.I.E.E. paper.)
Dr. E. B. Rosa and Mr. F. W. Grover	Absolute Measurement of Inductance.
Prof. E. Rutherford	Radioactive Change.
Prof. J. Trowbridge	Spectra of Gases at High Temperatures.
Prof. A. G. Webster	Recent Developments in Electrical Theory. (A. Phys. S. paper.)
Dr. Frank A. Wolff	The So-called International Electric Units.

SECTION B.—GENERAL APPLICATIONS.

Chairman, Prof. CHAS. PROTEUS STEINMETZ.

Secretary, Prof. SAMUEL SHELDON.

Prof. E. Arnold and J. L. La Cour	Commutation of Direct and Alternating Current Machines.
M. Andre Blondel	Calculation and Tests of Alternators.
M. Paul Boucherot	Variations of E.M.F. in Dynamos and its Influence on Operation in Parallel.
Dr. O. S. Bragstad	Theory and Operation of Repulsion Motors.
Col. R. E. Crompton	Standardisation of Dynamo-Electric Machinery and Apparatus.
Profs. Drs. Elster and Geitel	Natural Radioactivity of the Atmosphere and the Earth.
Herr Clarence Feldmann and Joseph Herzog	Distribution of Voltage and Current in Networks.
M. Alexander Heyland	Compounded Alternators with Alternating-Current Self-Excitation.
W. M. Mordey	Eddies and Hysteresis in Iron.
M. A. Nodon	Rectifiers.
Prof. S. P. Thompson	Predetermination of Plunger Electro-magnets.
Prof. C. A. Adams	Leakage Reactance of Inductance Motors.
Mr. C. Day	Electric Motors in Shop Service.
Mr. H. W. Fisher	Sparking Distances at Different Voltages.
Prof. E. B. Rosa, Dr. M. G. Lloyd and Mr. C. E. Reid	Influence of Wave Shape upon Alternating-Current Meter Indications.
Mr. D. B. Rushmore	Regulation of Alternators.
Prof. H. J. Ryan	Design of Insulators.
Dr. Clayton H. Sharp	Equipment of a Commercial Testing Laboratory.
Prof. H. B. Smith	High Voltage Transformers.

SECTION C.—ELECTRO-CHEMISTRY.

Chairman, Prof. HENRY S. CARHART.

Secretary, Mr. CARL HERING.

Geh. Reg. Prof. Dr. W. Borchers	Electro-Metallurgy of Nickel.
Dr. F. Dolezaleok	(Subject to be announced.)
J. Sigfrid Edstrom	Electrical Extraction of Nitrogen from the Air.
Dr. H. Goldschmidt	Alumino-Thermics.
Prof. Dr. F. Haber	The Carbon Cell.
Dr. P. L. T. Heroult	Electro-Metallurgy of Iron and Steel.
Prof. Dr. Richard Lorenz	Electrolysis of Fused Salts.
Prof. Dr. W. Ostwald	Electrolysis and Catalysis.
Mr. J. Swinburne	Electrolytic Smelting of Sulphide Ores.
Prof. W. D. Bancroft	Chemistry of Electro-Plating. (A. Electrochem. S. paper.)
Mr. A. G. Betts and Dr. Edward F. Kern	The Lead Voltameter.
Prof. H. S. Carhart and Dr. C. A. Hulett	Materials for Standard Cells and their Preparation. (A. Electrochem. S. paper.)
Dr. A. E. Kennelly and S. E. Whiting	Present Status of the Edison Storage Batteries.
Dr. K. E. Guthe	The Silver Voltameter.
Prof. L. Kahlenberg	Electro-Chemical Series of the Metals. (A. Electrochem. S. paper.)
Prof. J. W. Richards	The Energy Absorbed in Electrolysis.
Prof. T. W. Richards	Relation of the Theory of Compressible Atoms to Electro-Chemistry.

SECTION D.—ELECTRIC POWER TRANSMISSION.

Chairman, Mr. CHARLES F. SCOTT.

Secretary, Dr. LOUIS BELL.

Sig. E. Bignami	Electrical Transmission Plants in Switzerland.
H. M. Hobart	Design of Induction Motors.
Mons. Maurice Leblanc	Transmission of Alternating Currents over Lines Possessing Capacity.
Prof. G. Mengarini	Utilisation of Hydraulic Powers in Italy.
F. G. Baum	Long-Distance Transmission and Control.
F. O. Blackwell	Conductors for Long Spans.
H. W. Buck	Use of Aluminium as Electrical Conductors.
V. G. Converse	High-Tension Insulators.
M. H. Gerry, Junr.	Construction and Insulation of Transmission Lines.
L. M. Hancock	The Bay-Counties Transmission System.
R. F. Hayward	Practical Experiences in the Operation of Power Plants in Parallel.
J. F. Kelly and A. C. Bunker	Some Difficulties of High-Tension Transmission and Methods of Mitigating Them.
P. M. Lincoln	Single-Phase Railway Transmission and Distribution Problems.
Ralph D. Mershon	Maximum Distance to which Power can be Economically Transmitted. (A.I.E.E. paper.)
P. N. Nunn	Pioneer work of the Telluride Power Co.
J. S. Peck	The High-Tension Transformer in Long-Distance Transmission.
Dr. F. A. C. Perrine	American Practice in High-Tension Line Construction and Operation. (N.E.L.A. paper.)
Dr. C. P. Steinmetz	Theory of the Single-Phase Motor. (A.I.E.E. paper.)

SECTION E.—ELECTRIC LIGHT AND DISTRIBUTION.

Chairman, Mr. JOHN W. LIEB, JUN.

Secretary, Mr. GANO S. DUNN.

Prof. Andre Blondel	Impregnated Arc Light Carbons and Lamps.
Herr Max Deri	Single-phase Motors.
Herr E. de Fodor	Rates for Electricity Supply.
Sig. Ing. E. Jona	Insulating Materials in High-Tension Cables (A.E. Ital paper).
Prof. W. Kubler	Compensating Series-Connection of Induction Motors.
Prof. L. Lombardi	Stroboscopic Observations of the Arc. (A.E. Ital. Paper.)
H. F. Parshall	The Yorkshire and Lancashire Electric Power Companies.
Prof. August Rateau	Steam Turbines.
B. A. Behrend	Testing of Alternating Generators.
Alexander Dow	The Continuous-Current Distributing Systems of American Cities.
George Eastman	Protection and Control of High-Tension Distribution Systems. (N.E.L.A. paper.)
W. C. L. Eglin	Rotary Converters and Motor-Generators for Transforming to Low-Tension Street Current. (Assn. Ed. Illg. Co.'s paper.)
W. L. R. Emmet	Effect of Steam Turbines on Central Station Practice.
Herr Karl Roderbourgh	Prussian System of Electric Train Lighting.
Dr. G. Stern	Superiority of the Alternating Current for Distribution in Large Cities.
Dr. W. Wedding	Measurements of Energy of Light and Heat Radiation from Electric Sources.
Arthur Wright	Improvements in Electrolytic Meters.
Louis A. Ferguson	Underground Electrical Construction (Assn. Ed. Illg. Co.'s paper.)
Gerhard Goettling	Storage Batteries (Assn. Ed. Illg. Co.'s paper).
G. Ross Green	American Meter Practice. (N.E.L.A. paper.)
Caryl D. Haskins	Metering Efficiency on Customers' Premises.
Francis Hodgkinson	Steam Turbine Performance.
Henry Noel Potter	Nernst Lamps.
Dr. C. P. Steinmetz	Luminous Electric Arcs.
Philip Torchio	Distributing Systems from Standpoint of Theory and Practice.
Herbert A. Wagner	Electric Transmission and Distribution for Suburban Towns from a General Power Station.

SECTION F.—ELECTRIC TRANSPORTATION.

Chairman, Dr. LOUIS DUNCAN.

Secretary, Mr. A. H. ARMSTRONG.

F. P. Behr	The Mono-rail.
Ernst Danielson	Theory of the Compensated Repulsion Motor.
Philip Dawson	Electrification of British Railways.
Herr F. J. Eichberg	Single-Phase Electric Railways.
Prof. Dr. F. Niethammer	Alternating v. Direct-Current Traction.
Prof. Dr. Rasch	The Railway Booster Machine and its Control.
A. H. Armstrong	Electrification of Steam Lines.
Bion J. Arnold	Some Early Work in Polyphase and Single-Phase Electric Traction.
Dr. Louis Duncan	General Review of Railway Work.
J. B. Entz	Storage Battery in Electric Railway Service.
R. A. Parke	Braking High-Speed Trains.
W. P. Potter	Electric Railways.
F. J. Sprague	History and Development of the Electric Railway.
L. B. Stillwell	The Electrical Equipment of the Wilkesbarre and Hazelton Railway Co.
H. G. Stott	Central Station Economics and Operation.

SECTION G.—ELECTRIC COMMUNICATION.

Chairman, Mr. FRANCIS W. JONES.

Secretary, Mr. BANCROFT GERHARDI.

Senor Don Julio Cervera Baviera	Electric Communications in Spain.
Dr. J. A. Fleming, F.R.S.	Present State of Wireless Telegraphy.
John Hesketh	New Danger to Lead-Covered Aerial Cables.
Herr Joseph Hollos	Simultaneous Telegraphy and Telephony.
Saitaro Oi	Telegraphy and Telephony in Japan.
V. Poulsen	System for Producing Continuous Electrical Oscillations.
M. G. de la Touanne	Theory of Telephone Exchange Development.
J. C. Barclay	Modern High-Speed Printing Telegraph Systems.
Dr. Lee De Forest	Wireless Telegraph Receivers.
Patrick B. Delany	Rapid Telegraphy.
Franz J. Dommerque	Telephone Problem in large Cities.
Reginald A. Fessenden	Wireless Telegraphy.
Hammond V. Hayes	Loaded Telephone Lines in Practice.
J. C. Kelsey	Dunbar Two-Strand Common-Battery Systems.
Dr. A. E. Kennelly	High-Frequency Telephone-Circuit Tests.
Prof. Ferdinando Lori	Rapid Telegraphy.
Kempster B. Miller	Automatic v. Manual Telephone Exchange.
Dr. Louis M. Potts	Printing Telegraphy.
Col. Samuel Reber	Military Use of the Telegraph, Telephone and Cable.
Prof. George F. Sever	Electrolysis of Underground Conductors.
L. W. Stanton	Economical Features in Modern Telephone Engineering.
John Stone Stone	Theory of Wireless Telegraphy.

SECTION H.—ELECTRO-THERAPEUTICS.

Chairman, Dr. WILLIAM J. MORTON.

Secretary, Mr. WILLIAM J. JENKS.

Prof. Dr. M. Benedikt	Radio-Diagnostics of Diseases of the Head and Brain.
Dr. J. Bergonie	(Subject to be announced.)
M. le Docteur G. O'Farrill	Improvements in High-Frequency Generators.
Dr. J. Riviere	Physico-Therapy of Neurasthenia.
Prof. S. Schatzky	Effect of Constant Current on Vitality of Microbes.
Dr. Carl Beck	Recent Advances in Röntgen Ray Science.
Dr. Russell H. Boggs	Diagnosis of Calculi by Röntgen Rays. (A. E.-T. A. paper.)
Dr. Gordon G. Burdick	Radiations in Therapeutics.
Dr. Margaret A. Cleaves	Nature of the Changes in Living Tissue by Action of Oxidisable Metals at Anode.
Dr. Charles R. Dickson	Treatment of Lupus Vulgaris by Photo-Therapy, Radio-Therapy, and Otherwise. (A. E.-T. A. paper.)
Dr. Emil H. Grubbe	Roentgen Rays and Radio-Active Substances as Therapeutic Agents.
Dr. T. Proctor Hall	Principals of Electrotherapeutics.
Dr. W. J. Herdman	Du Puyten's Contraction. (A. E-T. A. paper.)
Dr. J. H. Kellogg	Electrotherapeutics.
John W. Langley	Electrical Purification of Drinking Water.
Prof. Jacques Loeb	Control of Life Phenomena by Electrolytes.
Dr. G. Betton Massey	Cataphoric Diffusion of Metallic Ions in Distructive Sterlisation of Cancer and Tuberculous Deposits
Dr. W. J. Morton	Artificial Fluorescence of Human Organism as means of Treating Disease.
Dr. C. S. Neiswanger	Static Electricity in Chronic Nephritis.
Dr. Clarence Skinner	Fibro-Sarcoma Treated by Roentgen-Radiance.
Dr. Wm. Benshaw Snow	Therapeutic Uses of Static Electricity.

Towards the end of this year a complete set of the transactions of this Congress will be published by the Committee, and will be purchasable by non-members for the sum of $10 (say two guineas); they can be obtained from the secretary, Dr. A. E. Kennelly, Harvard University, Cambridge, Mass., U.S.A. This set of proceedings will be of great value as a 1904 review of electricity and electrical engineering. The papers are the outcome of special invitations issued to the leading scientists and electrical engineers of the present time, this system resulting in a more satisfactory class of papers than is usually received in reply to a general intimation.

On Monday morning, September 12th, the work of the Congress was commenced with a general session, Prof. Elihu Thomson, the President of the Committee of Organisation, making an introductory speech. He was followed by the President of the St. Louis Exposition, Mr. D. R. Francis, who gave an official address of welcome. He pointed out that this Exposition would probably be the last of its kind, since the World was progressing too rapidly to allow of Universal Exhibitions; the exhibitions of the future would

probably be specialised, and one of the first of such exhibitions would probably be one devoted to electricity. It was most difficult to make a working classification to include everything, but he certainly thought the action of his committee in setting aside a separate building for electricity was justified. Speaking generally, the electrical department at St. Louis Exposition was a great advance on that at former World's Fairs.

The officers of the Congress were then elected, their names and offices being as follows :—

President: Prof. Elihu Thomson.

Vice-Presidents:

Mr. Bion J. Arnold	Mr. C. F. Scott
Prof. H. S. Carhart	Dr. S. W. Stratton

Prof. W. E. Goldsborough

General Secretary: Dr. A. E. Kennelly.

Treasurer: Mr. W. D. Weaver.

Honorary Vice-Presidents:

Prof. Moise Ascoli	Mr. R. Kaye Gray
Dr. R. T. Glazebrook	Prof. L. Lombardi
Senor Antonio Gonzales	Prof. John Perry
Col. R. E. Crompton	M. H. Poincaré.

In addition to the chairmen of each section, an honorary chairman and vice-president were elected from among the foreign delegates.

This business concluded, the Congress resolved itself into its various sections.

The papers read on this, the first day, were by the following authors :—

Section A.—Messrs. Guthe, Barnes, Kennelly, Rosa and Grover, Trowbridge and Townsend.
Section B.—Messrs. Mordey, Behrend, Nodon, Sharp and Jouaust.
Section C.—Messrs. Richards (T. W.), Betts and Kern, Richards (J. W.), Borchers and Dolezalek.
Section D.—Messrs. Bignami, Peck and Baum.
Section E.—Messrs. Roderbourg, Elgin, Eastman, De Fodor and Wright.
Section F.—Messrs. Dawson and Entz.
Section G.—Messrs. Hollos, Oi and Poulsen.
Section H.—Messrs. Hall, Herdman, Neiswanger and Skinner.

An adjournment was made at 1.30 p.m., so that the afternoon might be left free for visiting the Exhibition, &c.

In the evening the local Reception Committee held a reception in the New York State Building in the Fair grounds.

During the morning session, special arrangements were made by the local Reception Committee for the entertainment of the ladies of the party, who were taken to see the principal sights of St. Louis, in automobiles.

On Tuesday, the second day, papers by the following authors were read :—

Section A.—Messrs. Ascoli, Carhart and Patterson and Wolff.
Section B.—Messrs. Arnold, Steinmetz, Deri, Latour, Bragstad, Danielson, Niethammer and Lincoln.
Section C.—Messrs. Swinburne, Bancroft, Edstrom, Kahlenberg, Haber and Lorenz.
Section D.—Messrs. Kelly and Bunker, Mershon, Peck, Smith and Perrine.
Section F.—(In joint session with Section B. as above.)
Section G.—Messrs. Barclay, Delany, Ferdinando, Potts, Reber, Hesketh, Dommerque and Miller.
Section H.—Messrs. Schatzky, Beck, O'Farrill and Neiswanger.

Without doubt the most important of the papers read on this day was that by Dr. Frank Wolff, entitled "So-Called International Electric Units," the main object of the paper being to open a discussion on this important subject, before a joint meeting of the British and American Institutions of Electrical Engineers.

After Dr. Wolff had read his paper, Dr. Glazebrook, as a special delegate sent to the Congress by the British Government, opened the discussion. He mentioned that in giving his opinions, they would only be personal, as all such questions would have to be referred to the Government before acceptance. The two main points that had to be decided were (1) whether now, or at a future date, the Weston or Clark cell, or another cell, should be adopted as a standard ; (2) should the term "ampere" be derived in terms of a volt ? With reference to the Board of Trade definitions it was felt to be of great importance to adhere to the C.G.S. system. In a discussion on this subject, held some time back, Prof. Helmholtz suggested that these definitions should be obtained :—

(*a*) The ohm by the use of a mercury resistance.
(*b*) The ampere by the electric deposition in a voltameter.
(*c*) The volt from some form of standard cell.

At that time the British legal adviser pointed out that concrete forms of standards should be stated, which, of course, would not allow of the use of the above, so that the Board of Trade had had made and kept at London a standard coil for the unit of resistance ; a standard ampere balance, calibrated by comparison with the ampere obtained as suggested by Prof. Helmholtz, and a standard multi-cellular voltmeter constructed under Lord Kelvin's supervision. Technically in Great Britain the standards are represented by these three pieces of apparatus. Reverting to his two main points, and referring to the first, the question became really one of decision between the Weston and Clark cells. For all practical purposes the Weston was undoubtedly superior to the Clark. Personally, he did not agree with all that Dr. Wolff had said in his paper, though he did in the main. There was a difficulty in drawing up a specification for the Weston cell, which could be got over very easily when they had had a little more experience. Elaborate experiments had been carried out at the National Physical Laboratory on the defects of the Clark and Weston cells, the results agreeing with Prof. Carhart's experiments. Undoubtedly one of the greatest difficulties that had been met with in the construction of the Clark cell was that of the impurity of the mercurous sulphate, but he had now succeeded in obtaining this substance in a pure form by three distinct methods which were not known some 12 months ago. This difficulty was now, therefore, satisfactorily settled, and cells were obtained which agreed with each other within a few millionths of a volt, and which took up their full value soon after making. This result had drawn attention to another fact of importance. Cells prepared three years ago with as pure mercurous sulphate as could then be obtained, compared with each other, but not with newly-constructed cells. The determination of the E.M.F. of the Weston cell had not yet been accurately determined, and he was afraid that methods depending upon the twisting of a wire and the square of the radius of a small circle, as proposed by some of the American physicists, were not accurate enough, and that it would be more probable that a much better result would be obtained by a method in which comparisons were made by weighing. With the new Ayrton and Jones apparatus, now in preparation for the National Physical Laboratory, it was hoped that they would be able to publish some important results in a very short period. Though the Weston cell was undoubtedly better than the Clark, he did not feel inclined to displace it until such a time as the Weston cell had been accurately measured. Some form of cell as a standard was undoubtedly better than any electrolytic method. The practical man would always use the potentiometer method for calibrating his instruments because of its wide range, and from that point alone it would be advisable to use the same standard rather than a special one. It had been argued that since the changes in a silver voltameter are more readily understood than those going on in the cell, the former would be preferable, but in any case it would be advisable to wait a little while before finally settling the matter. He did not think that the electro-chemical equivalent of silver had been obtained with sufficient accuracy, and in a short time they might be able to obtain a better result.

(*To be continued.*)

ECONOMY IN ENGINE RUNNING.

[COMMUNICATED.]

WHILE consulting engineers may strive to produce combinations of plant which will give the maximum of economy combined with reliability, and while supply companies may do everything in their power to stimulate the consumption of electricity during those hours when the station is normally lightly loaded, the fact remains that much of the difference between success and failure may be accounted for by the way in which the various functions of running the plant are performed—whether repairs are effected in due time, and

whether the care which the plant requires is scientifically applied.

This needs to be insisted upon very strongly in the case of the engine room, because there is very little to show for all the thought expended in running the plant. In the boiler house, wastage of steam can be seen and heard at the boiler relief valves, wastage of water can be felt at the blow-down pipes, wastage of coal is apparent on examination of the thickness of fire and the density of smoke. But in the engine room the differences between economy and waste are much more subtle. The object of this article is to draw attention to those points in engine driving, care of which constitutes the duties of a good running engineer. No attempt is here made to evaluate the various points of engine house design which have from time to time been called into question.

It would be a very crudely-run station that had no appliances for collecting and filtering the oil used on an engine for further application. An oil filter is not an expensive appliance, and its practical effect is to make the charge-engineer less anxious to screw the oil consumption down to danger-point. He knows that if he keeps free streams of oil on, its value will not deteriorate so rapidly; he will be able to use it over again (with the addition of a little fresh oil to make up for wastage), and he will maintain his bearing surfaces in good condition by keeping them uniformly cool.

There is no doubt that oil clarifies much more quickly under heat than when it is cold, as it loses much of its viscosity with rise of temperature. Some types of oil filters now on the market supply this heat by means of a spiral tube passing through the oil-settling chamber, through which tube steam is passed. The economy of this process is open to doubt if live steam be used, however small the quantity may be. If, however, the coil be connected to the discharge pipe of the steam traps, we shall get a flow of hot water through it, answering the purpose very well. A rough-and-ready method of filtration, for use where the quantity treated does not justify the purchase of a special apparatus, is to place the used oil in a pail and, covering it so as to keep out dust, to stand it on the top of the engine cylinder cover or other warm place for an hour or so. Then, without disturbing the pail, the good oil is skimmed from the top of the contents and poured on to flannel or a pad of "meat cloths" placed over another pail. The oil thus filtered is ready for use, when cool, as "seconds oil."

It is economical to carefully study the nature of the rubbing-surfaces on the engines, and the work they have to do, with a view to getting the best variety of oil for that particular bearing. It is not economy to buy one class of oil and to use it everywhere. On a high-speed enclosed engine, for example, a heavy grade, high flash, non-gumming mineral oil must be used for cylinder lubrication, a much lighter oil—possibly a vegetable oil—being employed in the crank chamber. This latter oil, however, will be quite as unsuitable for the main bearings of a slow speed engine as would the cylinder oil above described. It may even be necessary to vary the nature of oil according to the time of the year—an oil which lubricates perfectly on a hot summer afternoon may be too viscous to flow properly on a winter's morning; the oil which has been thinned out for cold weather will be no better than water when the hot days come. It may be worth while to point out two fallacies which station engineers are apt to fall into, particularly in these latter days of continuous splash—or ring—lubrication. The first is, that a cheap oil will do just as well as an expensive one as long as plenty of it is used. Cheap oils are not only poorer in quality (being frequently "loaded" with adulterants), but sufficient care is not taken to purify the oil from free acid and grit. The saving in the oil bill is in course of time neutralised by increased cost of repairs. The second fallacy is, that the oil will go on working for ever. The symptoms of superannuation vary with different classes of oil. If the lubricant turns black, if it smells rancid, if it looks like thick soup, the time has come to throw it on to the coal heap provided that there is any calorific value in it.

It is not wise, however, to wait for such extreme symptoms as this. Knowing the time the oil was first put in, and the number of engine-hours run (from the station records) the life of the oil can be approximately calculated by observation. Once having got some data to go on, the oil should be changed some little time before its life is up, in order to treat the bearings as well as possible. Bearings repay every attention shown to them.

A word of warning must here be given as to the collection of oil from an engine. Pipes are usually led from the guide plates, oil trays, and other places where the oil lodges after passing the working parts, to a receiving tank where it may to some extent settle. If different classes of oil be used, these should on no account be allowed to mix, as the proportion of the combination may vary. For example, if, with high-pressure steam, heavy oil is used to lubricate the cylinders, this should not mix with lighter oil used for lubricating the guides and valve gear. Separate tanks should be used, and where there is danger of splashing owing to the motion of the engine, baffles should be put up to guide the oil to its proper drain.

In engines on shipboard it is possible, after having got the cylinder walls and piston rings into good condition, to dispense with any cylinder oil whatever after the first hour or two's run. This is because the engine is approximately equally loaded for the whole time, and also because the steam is usually wet enough to act as a lubricant. In central stations, economy cannot be carried quite so far owing to the variation of load and the very dry (possibly superheated) nature of the steam. As proper cylinder oil is very expensive, however, the greatest effort should be made to cut down the drops per minute to the lowest number, as the oil is not only irrecoverable with profit (due to emulsification with the condensed water), but there is a danger of deleterious action on the air pump valves (particularly if of rubber) and other working parts, and the condensed water cannot be used for boiler feed. In vertical engines, at any rate, an occasional drink of oil at start is all that should be administered to the intermediate and low-pressure cylinders, the lubrication being then effected by the oil passing over from the high-pressure cylinder. Horizontal engines usually require more attention. It is, however, possible to dilute the heavy cylinder oil with a lighter and cheaper quality for use on the low-pressure cylinder. Where oil can be collected from an "oil separator pump," this "seconds" oil can be economically used on the low-pressure engine.

A very fruitful source of waste in running an engine is the absence of strict attention to the condition of its steam joints and glands. A small jet of steam has not a very imposing appearance, but any engineer who studies his coal bill will seize the first opportunity to remake the joint (if tightening-up is of no use) or to repack the gland. A more insidious form in which this waste occurs is found at the steam trap. This should only open to discharge condensed water, but, particularly where small valve-surfaces are employed, it gets out of order in course of time, and steam passes continuously to waste. Each trap should have a three-way cock attached to its discharge so that it may either blow out into a common discharge-drain, or into the atmosphere in view of the engineer, who should periodically, while the engine is running, divert the discharge by means of this cock, from its normal course to the drain, into the atmosphere. If there is a flow of steam the trap should be put under repair. Where the valve-stem is accessible without taking the trap adrift, the valve should be rotated slightly every now and then, to prevent grooving going on at any particular part due to passage of grit with the steam and water. The joints and bearing surfaces of any moving part of the trap exposed to air should be kept well oiled to ensure smooth working.

The air pumps and condensers of an engine (no modern central station engine would be run non-condensing unless the station were most unsuitably placed for condensing water) give seriously uneconomical results unless they are watched. An air leak may lower the vacuum one or two inches, and throw a lot of extra work on the air-pump. Such a leak is difficult to detect by sight or sound, but should be searched for periodically with a lighted candle, which should be passed carefully round all joints in the exhaust pipe and condenser. Any indraught of air will deflect the flame.

Once having obtained an economically good vacuum, it is wasteful to increase the amount of circulating water beyond

the flow necessary to just keep that vacuum, as more work is uselessly put on the pumps. Particularly should this be avoided when (as is often done) either the condensed or condensing water is taken to the hot-well for boiler feeding. Increased volume means lower temperature of the water, and the higher the temperature of the hot-well the better, consistently with a good vacuum.

The question of the proper quantity of cotton waste to be allowed per diem is often a very heated one as discussed between the engineer and driver. The former wants to keep his costs down; the latter wants to keep his hands clean. Two methods may be adopted. One is not to give an extra half-pound until the men are nearly mutinying for it; the other is to give the men what they want, and keep a sharp eye on the waste-pail. If any unsaturated handfuls of waste are placed therein for removal to the stokehold, it is time, firstly, to cut down the allowance of waste relentlessly, and, secondly, to speak some home truths to the drivers, with the unsaturated waste as an object-lesson. Probably the latter course is best, as the men have then no excuse for neglecting the cleanliness of the engines. A little method introduced into the use of waste would, however, bring down the cost of this item considerably. The clean waste should be reserved for fine work—bright parts which require an artistic touch or two. Then the waste should be used for ordinary wiping over, and finally, when it is getting rather used up, it serves to wipe the oil off foot-plates and other parts, which are never more than comparatively clean. It cannot be used much more in the engine room, but is still of service for rough machinery in the boiler house, such as mechanical stoking gear. When even the stoker reviles it, the heat value of its accumulated grease can be used to advantage in the furnace. Again false economy must be guarded against. White waste is probably a luxury only to be found in Corporation stations, but there are grades of coloured waste. The grade to avoid is that very cheap variety which contains foreign matter, ranging from sandy dirt to the domestic pin. It is not economical either to rub grit into the valve motion, or to poison the driver's thumb. In the latter case, under the present facile administration of the Employers' Liability Act, the driver will, quite probably, get compensation if he be temporarily incapacitated for work.

Some engineers prefer to use meat-cloths (the cloth in which frozen meat has been wrapped during shipment), on the ground that, although more expensive than waste, they can be washed. In the writer's opinion, however, the washing of oily rag is too expensive to recommend its adoption. Meat-cloths have this advantage for fine work, however, that no loose strands are left about to work into the moving parts.

A good deal of useless cleaning is done on an engine. Working parts and dust-catching parts should be kept scrupulously clean. But many engine builders succumb to the temptation of making an attractive looking engine by putting an unnecessary amount of bright work about it. This, while good policy from the engine maker's point of view, and pleasing to the artistic instinct of the borough councillor, is a source of loss both in time and material. An engine is for use, not ornament, and it is not unreasonable for the engineer to consider whether some of these bright parts would not look almost as well and be quite as useful if covered with a neat coat of paint. In the Navy the practice of keeping the big guns bright has been abandoned in favour of coating them with an acid preparation which produces a close-fitting skin of iron oxide, preventing further rust. Why should not the same kind of thing be practised in a power supply station?

AN ELECTRICAL METHOD FOR THE ESTIMATION OF CARBON DIOXIDE.

A paper was read before the Physical and Chemical Section of the Gesellschaft Deutscher Naturforscher und Aertze at their seventy-sixth annual meeting (held in Breslau last September) on the above subject by Herr G. Bodländer, of Brunswick. An account of the communication was published in the *Chem. Zeit.* (1904, xxviii., 928), from which we take the following particulars:—

The process depends upon a measurement of the acidity which is conferred upon an aqueous solution by a current of carbon dioxide.

When a gaseous mixture containing carbon dioxide is led through water, the liquid takes up a quantity of the gas corresponding with the partial pressure of the CO_2. To a small extent the dissolved CO_2 dissociates into the ions $H^{\cdot}$ and HCO_3^{1}; and the ratio $[H^{\cdot}] \cdot [HCO_3^{1}] = 12{\cdot}6 \times 10^{-9} [CO_2]$, in which $[H^{\cdot}]$ and $[HCO_3^{1}]$ are the concentrations of the two ions in gramme-molecules per litre. If the solution is very acid, the concentration of the H-ions derived from the carbonic acid is but slightly altered; and if the solution is neutral, an equal amount of $H^{\cdot}$ and HCO_3^{1} ions are produced. Then $[H^{\cdot}] \cdot [HCO_3^{1}] = [H^{\cdot}]^2$; *i.e.*, the square of the concentration of the $H^{\cdot}$-ions is proportional to the partial pressure of the carbonic acid. This proportionality is most accurate when the liquid contains bicarbonate; then $[H^{\cdot}]$ is proportional to $[CO_2]$. The acidity can be measured very exactly by observing the electromotive force. The E.M.F. of a system, *e.g.* Zn | Zn SO_4 | H_2SO_4 | Pt depends, *inter alia*, upon the concentration of the H-ions, rising, according to Nernst's formula, to 0·058 log p volts as the concentration of the H-ions increases from 1 to p. When oxygen is brought into contact with the platinised platinum electrode, it is depolarised, and the separation of hydrogen hindered; but the same relationship remains between the E.M.F. and the H-ions present. If a current of oxygen and carbon dioxide is led through the liquid, the E.M.F. depending upon the amount of CO_2 in the current is altered, because that amount determines the concentration of the hydrogen ions.

In order to use this principle in measuring the partial pressure of CO_2, the following electrical system is employed:—Ag | Ag Cl | KCl + $KHCO_3$ + K_2SO_4 | Pt. The energy of the reaction in this system, and its E.M.F., depend on the concentration of the potassium chloride and potassium bicarbonate in solution, and on the amount of O and CO_2 in the gaseous mixture. The E.M.F. increases with the amount of CO_2 in the gas; the increase being the more conspicuous as the amount of CO_2 is the smaller. Hence this electrical method may be employed for the estimation of CO_2 instead of the usual gas-volumetric process, which is very inexact in low concentrations. The operation is so delicate when small quantities of the gas have to be determined, that it is very serviceable in examining products of combustion or ordinary air, and for making continuous tests upon the atmosphere of mines. The author accompanied his paper by a demonstration.

THE JUNIOR INSTITUTION OF ENGINEERS.

Summer Meeting in Germany.

Contrary to its usual practice, the Junior Institution of Engineers extended its summer meeting this year to the period of a fortnight, as the country selected for visiting was Germany.

The reception met with throughout the tour was cordial in the extreme, the proprietors, officials and authorities of the works, &c., which were open to inspection, sparing themselves no pains or trouble to render the occasion both instructive and pleasant to the members, and such it proved to be.

A large portion of the programme was inevitably devoted to subjects electrical; indeed, a commencement was made on the very first day, August 14th, during the visit to the International Fine Art and Horticultural Exhibition at Dusseldorf, evidently arranged for purely recreative purposes, but yielding technical interest; for all the electric machinery and appliances there were brought under the observation of the visitors, including the important installation of generators in the central station, some being driven by steam, and others by means of gas engines of large power.

The great iron and steel works of the Gutehoffnungshutte, at Oberhausen, were visited on the following morning, and the Beurather Crane Works in the afternoon. At the latter, a number of electric cranes were shown in course of construction. The shop machinery is driven electrically, a well-appointed central station, with a battery of boilers, having been built in connection with the works, but most of the current required is taken from the town supply. The works station contains three machines by the Union Elektricitäts Gesellschaft, of Berlin, each of 220 volts and 400 amperes capacity, driven by vertical steam engines, direct coupled, and running at 180 r.p.m. The boilers are by Jacques Piedbœuf, of Dusseldorf, and work at 9 atmospheres pressure.

On arrival at the city of Elberfeld next day, attention was directed to the Barmen Elberfeld Vohwinkel Electric Langen mono-rail suspended railway, the whole morning being spent in its examination. Power is derived from the municipal generating station, in which were seen several large-power steam turbines and alternators, notably the one of 1,000-kw. capacity made by Messrs. C. A. Parsons and Co., of Newcastle-on-Tyne. The car-sheds and railway repairing shops were also shown, and the members had the experience of a journey the whole length of the line, stoppages being made for the inspection of any special points of interest. There are 20 stations along the 8¼ miles of line. Each carriage (of which there are 50 running) can accommodate 50 passengers. The starting current required is 100 amperes, and when running 30 amperes. The carriages are suspended from two bogies, 26 ft. apart, each running on two wheels 35 in. diameter, driven by spur gearing from a 36-h.p. electric motor, which is fixed between the two wheels and projects outwards. The weight of a carriage, with its full complement of passengers, is about 14 tons.

The party travelled on from Elberfeld to Hanover, visiting there the celebrated gas-engine works of Messrs. Körting Brothers, the Hanover Locomotive Works, the Westinghouse Brake Co.'s works, and the Hanover Gas Works, there to see at work the new Paris electro-turbine gas retort charging machine, which has just been introduced. Messrs. Körting's works were fully occupied, some of the gas engines they are engaged upon being of the large-power variety, and double-acting. The output of the works is equivalent to 30 000 H.P. per annum. A large business in radiators (hot water) is also carried on, an extensive foundry equipped with moulding machinery, &c., being kept constantly employed.

The day following was spent in visiting, under the able guidance of Mr. L. Körting, President of the German Association of Gas and Water Engineers, various places of general interest at Hanover, and in the journey on to Berlin, where on the next day the overhead and underground railway was seen in the morning, the works of Messrs. Siemens & Halske in the afternoon. It is unnecessary to enter into any description of the Berlin line, as it has already been dealt with in our pages, but it may be said that the undertaking continues the successful career which it started right from the time of opening, and that the whole work reflects great credit on all concerned, particularly Messrs. Siemens & Halske.

At their Charlottenburg works the members had shown to them the methods employed in the machining and fitting of parts for large multipolar generators, smaller dynamos, motors, &c.; also the systems in connection with the manufacture of resistances, starting and regulation resistances, apparatus, and so forth. Appliances for electric lifts and cranes, switchboards, high current apparatus, cut-outs, &c., were likewise seen, and the special processes in their construction pointed out. The arc lamp department was also included in the visit, the room in which the various types of lamps produced were undergoing scientific testing, affording considerable interest. The lamps included the Liliput 24-hour 2-ampere arc, suitable for interior lighting, and those having carbons capable of burning 240 hours.

On Saturday the Mariendorf works of the Imperial Continental Gas Association were inspected, followed by a visit to the Royal Technical High School at Charlottenburg, a striking educational organisation, and justly holding a position of considerable importance amongst similar schools of the world. The number of students specialising in electrical engineering approaches 500, and the department in which they are trained is well equipped with typical machines and apparatus of all kinds. The magnitude of the whole school may be appreciated from the fact that the total number of students is about 5,000, while the teaching staff numbers about 500. From Berlin the members proceeded to Leipsic, visiting the Pittler lathe works, and then on to Frankfort-on-Maine.

During the second week, the places of electrical interest visited were at Frankfort-on-the-Main, and Hanau, and comprised the magnificent central station at the former and the sewage pumping station at the latter, containing four centrifugal pumps made by R. Wolf, of Magdeburg, driven by continuous current motors from Messrs. Schuckert & Co., of Nuremberg. The two larger pumps are driven by two 50-H.P. motors which can be coupled to drive either one or the other, or both together; the smaller pumps have each a 30-H.P. motor. At the Frankfort Electricity Works the members had the advantage of being shown over these by the designer—the former municipal engineer to the city—Mr. W. H. Lindley, M.Inst.C.E., who is also responsible for a number of other projects in various parts of the Continent. The current supplied is an alternating monophase current of 3,000 volts transformed to 120 volts. There are four compound tandem engines by Kuhn, of Stuggart, generating 522 KW.; four compound tandem engines by Sulzer, of Winterthur, generating 1 000 KW.; one Parsons steam turbine by Brown, Boveri and Co., of Baden, generating 3,000 KW. All the alternators are also from that firm. The converting station of the Frankfort electrical tramways was seen—an underground building situated in the middle of the city, under the Schillerplatz. The whole of the electrical installation, with the exception of the accumulators, has been supplied by Brown, Boveri & Co., and consists of four converters generating 500 KW. continuous current, of one synchronous continuous current converter of 60 KW. for charging the accumulators, and of the switchboards. The converters consist of motor and dynamo directly coupled, running at 340 r.p.m., the motors being on the Braun one-phase system for 2,850 volts, and 750 H.P. effective. The battery, by Messrs. Pollak, consists of 552 double elements, and discharges 920 amperes in one hour.

In returning from Frankfort the opportunity was not lost sight of for the usual trip down the Rhine, the steamer being taken at Biebrich and left at Bonn, whence the journey was continued by rail.

At the different places in the course of the tour the electric tramway systems came in for a good deal of discussion, as it was possible to draw contrasts between their points of construction, equipment, and management. The excellence of their running was generally commented upon.

Erith and Tramways.—On 5th inst. a deputation from Erith (the whole Council is is said) visited Leicester, and made an inspection of the electric tramway system. From Leicester they journeyed to Loughborough to inspect the Brush Co.'s Works, then to Derby, Sheffield, and Manchester, and finally to Preston, to the works of Messrs. Dick, Kerr & Co.

ENGINEERING APPRENTICESHIPS AND TECHNICAL EDUCATION.

We have on previous occasions* referred to the changes which modern conditions, resulting largely from the ever-increasing use of labour-saving machinery, have made necessary in the training of engineers. The days in which an engineer was a man who could handle and make every kind of tool necessary for the manufacture of a machine, be it an engine or any other mechanical contrivance, have gone—for the present. That such days may return is problematical. A time may come when men will refuse to be mere automata, watching a machine usurp work which they may think is by right their own. The strenuous life, and the concentration resulting from specialisation, cannot go on increasing in intensity for ever; and when the breaking-down point is reached, and man has discovered that his many-sided nature cannot live by bread alone—bread that is bought at too great a price, the price of his better self—the revolt will come, and the automaton will claim his birthright—his right to work.

But we are concerned with the things of the present—our legacy from the past—nor dare we pause to consider what kind of world it will be that we shall hand on to the future generations.

Leaving the so-called working man for the moment and turning to the engineer proper, it is not sufficient nowadays that a youth should be merely apprenticed for so many years in a manufacturing works. It is necessary that he should go through a special preparatory training at a technical school or university. At a meeting of the Manufacturers' Section of the London Chamber of Commerce, held a few months ago, a paper was read by Mr. A. C. Holzapfel on the subject of technical education, when the following resolution was moved:—"That in order to retain our industrial position, and to introduce into this country such further industries as may be profitably developed, this section is of opinion that it is absolutely necessary to raise the standard and cheapen the cost of technical education, and that representations be made to the Board of Education in this sense." It has long been thought that we are very much behind both America and Germany in the matter of technical education, and it is felt in some quarters that a measure for financial aid should be forthcoming from the State, and not only from the State, but from private sources, for throwing open avenues of high class technical and scientific education to all who have the inclination and ability to devote themselves to such a course of study. This, in itself, is not sufficient if manufacturers do not see the necessity of employing the most capable scientific men to carry on such work, and to further encourage technical education by giving the preference to those who have distinguished themselves at a technical college.

In July last a deputation from the British Association waited upon the Prime Minister in order to urge upon the Government the advisability of affording State Aid to technical education, more particularly to the scientific training necessary in relation to manufacturing industries. It was then pointed out under what disadvantages we, in this country, suffer as compared with the peoples in America and Germany, where technical education is largely stimulated by grants either from the State or from wealthy capitalists.

The Prime Minister, however, in reply, showed that there was even a greater necessity than a well-equipped technical University, which was that capitalists should be prepared to realise the necessity of giving employment to those whom the Universities turned out. He was of opinion that evidence went to show that manufacturers generally preferred to employ men whose experience was acquired in actual everyday labour in the works, and in the erection of plant, rather than those men of higher scientific attainments whose practical experience was confined to the workshops of a technical college.

But there is evidence, as we have pointed out in previous articles, that some of our manufacturers are beginning to recognise the advantages of a sound technical training, and details were then given of the modern form of apprenticeship which has been

* "The Evolution of the Engineering Apprentice," February 26th, p. 325; "The Modern Engineering Apprenticeship System," March 18th, p. 446; "The Training of Engineers," May 6th, p. 786.

recognised by the North-East Coast Institution of Engineers and Shipbuilders, and is destined to become the model on which all future engineering apprenticeships throughout the country will be based. This apprenticeship, it will be remembered, combined a technical college training with workshop experience. It might here be added that the Armstrong* College of Science, Newcastle-on-Tyne, which is the training ground for the North-East Coast engineering industries, is largely supported by the beneficence of the local manufacturers.

We are pleased to learn that the system of apprenticeship referred to is not confined either to the North-East coast, or to those large works which are of American origin, but that a similar system is in vogue in other places, including the Stafford works of Messrs. Siemens Bros., Ltd. Here, as in the other works named, there are two classes of apprentices, namely, the ordinary apprenticeship for youths who wish to qualify themselves in the first instance as workmen, and who must have passed a school standard equal to the sixth standard of the Board School; and another class for young men who have had a college or university education, and wish to qualify as electrical engineers. From neither class of apprentices is any premium required or accepted.

Before acceptance as an apprentice, a youth is required to work for three months on trial, keeping the ordinary workshop hours, and if at the end of that time he should not be satisfied with the conditions, or have any doubt as to his ability to strictly meet all requirements, he is at liberty to leave the company's service. If, on the other hand, he wishes to remain, and the company agree to accept him as an apprentice, he is required to execute the regular form of agreement covering a period of five years for the first class named, or two to three years for the higher grade.

Both classes of apprentices are paid the same rate of wages, namely, commencing at 1d. per hour for time actually worked, advancing to 3½d. per hour if conduct and ability merit such advance. Overtime, if worked, is paid for extra in accordance with the general regulations in force. The working week is 52 hours, and great importance is attached to regular and punctual attendance.

Certificates are issued at the end of the apprenticeship to those who complete satisfactorily the full time. This certificate states the class of work on which the holders have been employed, their abilities and general character, and also gives a record of the number of hours worked and the time lost, &c.

It will be noted that the only advantage gained by a youth who has gone through a system of technical training is the shorter apprenticeship. So far as remuneration and other conditions are concerned, he is on all fours with the ordinary apprentice.

In the North-East Coast system previously referred to, and also in the Westinghouse and other American systems, the technically-trained apprentices start at a higher wage than the ordinary apprentice, and maintain this advantage throughout, and also pass through several departments, including the drawing office. Messrs. Siemens Bros.' agreement does not preclude their giving a preferential rate to the higher grade of apprentices if these are deserving, and whilst not binding themselves to do so, they make it a point of recognising special merit by increased pay.

All apprentices before being bound must bring a medical certificate, and a certificate of good conduct from school or college. They must also enter into an agreement not to take out or be interested in any letters patent whatever, here or abroad, while in the firm's service, or afterwards for any invention made whilst in their service, but they must communicate to the company and place at their disposal any such invention, and the board of directors are to have the right to decide as to whether permission shall be given to the apprentice to take out his patent and upon what terms, or whether the company should conjointly with him patent the invention. Further than this, he is to assign to them, without any pecuniary compensation, his interests in any such invention, whether letters patent or otherwise. The terms of this seem somewhat stringent, but no doubt the the company have good reasons for making these stipulations. It might appear at first sight that such conditions would tend to stifle inventive genius, but Messrs. Siemens Bros.' record would tend to disprove any such assumption, as the patent records show a very large number of patents taken out by them conjointly with their employés.

Employment at the conclusion of the apprenticeship is, of course, not guaranteed. It would be practically impossible for any firm to make any such guarantee.

To revert to the question of technical education, Mr. Holzapfel in the paper already referred to makes some very pertinent remarks both as to the cost of technical education in this country, and the standard of the training given as compared to that given by Germany. Touching on the question of cost, he said that one of his own sons was studying chemistry at King's College, London, and another at Aix-la-Chapelle, in Germany. The fees in the first case are over £50 a year, and in the second under £10.

Then as to the standard of training, men who ought to know send their sons to Germany to study, rather than to English colleges. The author of the paper met in a German railway two nephews of the Pres. Inst.C.E., who were studying engineering in Hanover on the advice of their uncle; and Prof. S. P. Thompson, in his 1902 report of the work at Finsbury Technical College, speaks of the number of students who proceed to Germany to complete their studies.

"It is hardly dignified," says Mr. Holzapfel, "for the richest country in the world that it should not be able to give its sons that education which they are able to get in poorer countries." He considers that our Government "should devote several millions yearly for the purpose of building and maintaining technical high schools of the most modern order in all the principal industrial centres, which would give proper courses in all the most advanced aspects of technical knowledge at nominal fees, so as to enable young men from the less wealthy classes to be attracted to these studies."

And to what end is that money to be spent? It is in order that we may maintain our industrial position, without which it will be impossible for the country to support its 40 million inhabitants; it is in order to hand down to our children the industries of this country in a healthy and strong condition, capable of competing with all the world. So much for the patriotic side of the question.

And what of the individual student? The working man, who must start his long apprenticeship on the top of a Board School sixth standard foundation, already complains that at the end of his time his work is to watch machines whilst they turn out products, the making of which would, a few decades ago, have given employment to scores of men. His work, if he does anything at all, consists in moving a lever now and then, or feeding the machine with fresh raw material. He is almost an automaton. In fact, he is the servant or lackey to a machine, he who would scorn to be the menial to any man. He wonders, at times, how it is that, with the enormous multiplication in the means of production, poverty is not less, but greater; in fact, where poverty *was*, starvation *is*; and why the struggle for existence is not less hard, but keener, and why millionaires increase in number as the condition of the poor becomes poorer. But the machine wants feeding, and its human slave obeys its mute demand, happy to have something to distract his thoughts.

But the technical graduate who, after a public school education, has devoted three or four years to concentrated study in a technical college, followed by two or three years in the workshops, is surely in a better position.

If one is to judge by the recent correspondence in the columns of the Electrical Review, his state is even worse than that of the workman. The latter can generally get his 30s. to 40s. a week, whereas our fully-fledged electrical engineer must offer bribes to get a post, where he will give his services either gratuitously or for a mere acknowledgement. And what of the successful? One may be put in the drawing office to specialise on armature cores, another magnet windings, another on commutator details, and so on. All day long he is engaged on one small section of a machine with wearisome monotony, and night after night he is studying, studying, studying, in the hope of fitting himself for something better, working night and day to earn bread, starving the social and spiritual sides of his nature which feed not on bread. "Our designers," recently said a managing director of a large up-

* Until recently called the "Durham College of Science."

to-date works (and the M.D., who draws his more than living wage, probably never saw the inside of a technical college) "Oh! we keep them under lock and key, we spoon-feed them in glass cases; they are not allowed in the works. Oh no, they are dangerous!" Well might our budding electrical engineers ask, "Is the game worth the candle," if this be the end of it all.

CORRESPONDENCE.

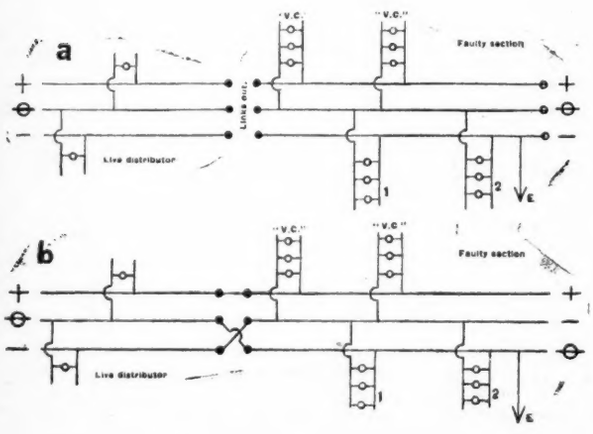
Letters received after first post on Wednesday morning cannot appear until the following week.

Groves: Localisation of Faults on Low-Tension Network.

In the above paper, read before the Institution (Birmingham Section) in March last, and just published, the author, speaking about distribution on a three-wire system, states:—

"If a fault is partially localised on either outer, but cannot be eliminated before dark, the main may be cross-coupled in the nearest junction box, making the faulty cable neutral. . . . . There is a risk of breaking lamps on the crossed circuit, but it is better to take this risk for a few hours than put many consumers in darkness. The meters of some consumers will also be temporarily reversed, but extinction is always the greatest evil, and the reputation of the supply business is of more value than units unrecorded or cancelled by the meters."

Now, on triple-concentric distribution, it is hardly possible to get an earth on either the + or − without the neutral being also earthed. In other words, on T.C. distributors we would



get a dead short, so I presume that Mr. Groves is talking about single distributors, although he does not say so.

Now, to fully appreciate Mr. Groves's dry humour when he states that "there is a *risk* of breaking lamps," it is only necessary to look at two simple sketches:—

(*a*) The faulty main cut out before Mr. Groves had *risked* breaking lamps!

(*b*) The faulty main giving the unfortunate consumers (marked "V. C.") light!

It will be seen that the two consumers, "V. C.," connected as Mr. Groves suggests, will get more than they bargained for in the matter of juice! In fact, every lamp they switch on will be blown out with a loud report! These consumers ("V. C.") will hardly agree with Mr. Groves that "extinction is always the greatest evil." Not even incandescent lamps of German manufacture will stand double their voltage!!! Now, the consumers on the other side (1) and (2) will get a proper light, although, as Mr. Groves says, their meters will be reversed. The arc lamps belonging to Mr. (1) will, however, be burning upside down, and his semi-enclosed arcs in the window will be doing their best to dash their brains out. Again, Mr. (2)'s Nernst lamps will burn out. These, however, are small matters compared to what the "V. C.'s" will say when they come round to the office in the morning! There would be too many "cross couples" about for the "reputation of the supply business."

A. J. Abraham,
Chief Assistant.

Partick, *October 8th*, 1904.

Intercommunication of Tramway Systems.

I note in the leading article of your current issue that you state that the Corporation (meaning the Bolton Corporation) doggedly decline to enter into any arrangements for the convenience of the travelling public, and I should like to know on what evidence you base this statement. You state that at these times it has been found that the receipts of both the Corporation system and that of the company have far exceeded those previously obtained (the times referred to being those when we had a through system between the South Lancashire Tramways system and our own). I should like, again, to ask you where you obtained the evidence of the receipts of the Corporation having at such times far exceeded those previously obtained. It seems to me that the writer of this article must have written this article after having got evidence only from one side of the case, a not unusual thing for a writer in an anti-municipal paper to do, but I think in common fairness the other side should be asked to state their case, and in connection with this matter I can say that it would not in any way bear out the interpretation which your article is intended to convey. We have had through running with the South Lancashire, but that it helped our receipts is incorrect; it very much interfered with our service in our town, and we lost money by it.

I can assure you that the members of the Tramways Committee of the Bolton Corporation are not so indifferent to profits that any service that will pay them will be rejected on their part. I can assure you also that they are perfectly willing—in fact, anxious—to run in conjunction with any neighbouring authority, and I am quite prepared to prove to any person who is open to conviction, that if running powers with neighbouring authorities are not adopted in our case, no reasonable person could expect that they would be under the conditions imposed. To prove the statement which I make with respect to the Tramways Committee of the Bolton Corporation, it is only so recent as last week that they have had a meeting with the Bury Corporation, with a view to joining up with Bury expressly with the object of running through traffic between their town and ours.

Arthur A. Day,
General Manager.

Bolton Corporation Tramways,
October 8th, 1904.

[We are very willing to afford Mr. Day every facility for stating his side of the case, and if we have misrepresented the attitude of the Corporation of Bolton *vis-à-vis* the South Lancashire Tramways Co. on the question of through communication, we deeply regret the fact. Our remarks were based on evidence which we had no reason to doubt, and that our attitude is not one of blind opposition to all municipal enterprise is sufficiently demonstrated by the first part of the leaderette to which Mr. Day alludes, in which we pointed out the benefits accruing from the friendly co-operation of the Liverpool Corporation with the neighbouring tramway undertakings. We are only too pleased to learn that Bolton realises the value of inter-communication.—Eds. Elec. Rev.]

Electric Winding.

The causes of the great waste of steam in steam winding are as follows:—

1. The very large amount of condensation that takes place, owing to the fact that the engine is standing for a large portion of the 24 hours, but must be ready to wind at any minute, that it stands between each wind, even when winding is at its busiest, and that even for a portion of the wind itself, the steam is cut off from the engine.

2. The fact that the boilers must generate sufficient steam to meet the heavy demands made by the winding engine,

without seriously lowering the pressure of the steam supplied to other engines on the same service.

3. The large amount of work done at each wind during the acceleration period, and the demand for steam for braking at the end of the wind.

4. The necessity for provision for lifting the full length of the rope at the commencement of the wind, while this length is not only continually decreasing, as the wind proceeds, but the descending rope is continually lengthening, and the descending cage is continually acquiring momentum throughout the wind, though no benefit is obtainable from this fact, beyond shutting off steam at a certain portion of the wind, and thereby leading to additional condensation.

I should say that if the whole of the steam properly chargeable to the wind were divided over the actual brake-horse-power expended in winding, the amount would be pretty startling, and would leave far in the shade the largest of the figures used by Mr. Hooghwinkel. As far as my experience goes, there are not many winding engines in use that wind for even 125 lbs. of steam per I.H.P.

The great advantage of the Siemens-Ilgner system of electric winding is the fact that it enables all the energy stored in different parts of the apparatus, due to the fall of the descending cage, to be made use of, less, of course, the usual charge for conversion; and it has also the great advantage, as I understand Mr. Hooghwinkel and others have pointed out, that it enables the economies due to generating electricity on a large scale to be realised. In place of the colliery boilers being obliged to be kept going all night for the winding engine, the fan engine, and possibly the electric light engine, with the necessary waste of steam during the interval between the winds, the winding and other engines go in with those of other collieries, or other works. It is hardly necessary now to repeat the argument that economy is realised by generating power at a central station and distributing, from the fact that, in any works all the machines are never at work together, and so the power that would have been used for the machines that are standing in any particular works, can be used to drive machines in other works. Putting the winding engine on the electrical supply, instead of keeping one or more boilers going for it, enables that economy to be realised.

The reasons why colliery managers are not chasing each other in the race for electrical winding engines are economical.

There are two economical laws which rule in these cases. Whenever a new machine is contemplated, the outlay is only economically sound when the saving in the cost of the process of which it is to form a part, or alternatively the increased selling value, is sufficient, during the useful life of the new machine, to pay all costs of installation, and leave something over. By costs of installation are meant the cost of the machine, and of fitting it up, with any contingent costs such as those sometimes incurred in learning to use a new machine, and from the total sum may be subtracted any amount realised by the sale of the old machine.

The other economic law refers to mines more particularly, and it states that the whole of the cost of opening the mine, of working it, and of putting the mineral on the market, together with a certain interest on the capital outlay, must be repaid within the period of the life of the mine.

It will be seen that these two laws have a very important bearing upon the question of the introduction of any new apparatus. German collieries have a longer life before them than the generality of British collieries, and hence they have greater inducements to expend large sums upon apparatus which, after all, though they promise very well indeed, are still new; and the mine owner is wise to allow German mine owners to experiment, instead of doing so himself. Apart from this also, though it is practically certain that mines will, one and all, be worked by electrically-driven machinery, it is by no means certain that a simple mechanical solution of the winding problem may not be more economical. Thus it has been proposed to work mine shafts on the elevator principle, with either an endless rope or chain continuously running in the shaft. As the rope or chain might be driven by electric motors, it appears to me that this arrangement at least offers a good possible solution of the problem. Our German friends may take this view of the matter later on, and if so, we shall not be long before we see it tried. Meanwhile, of all the different systems that have been proposed for winding by electricity, the Siemens-Ilgner appears to me to be the only sound one, from an economical point of view, for large plants. Perhaps I may be allowed to mention that when I pointed out the possibility of electricity being used for winding in the South Wales Institute some five years since, I was told that there was nothing like leather.

Sydney F. Walker.

Bath, *October 8th*, 1904.

Master and Man.

Various articles and letters have appeared in your valuable paper for some time past relating to the status and morality of working men, employers, students, &c. I very much question whether you or your correspondents have dug deep enough to find out the cause of the growth of all these numerous ills that have such prolific crops.

Inasmuch that the people in a locality elect certain folk to represent them in a council or board, and those representatives in turn appoint officials to carry out their behests, is it to be wondered at that we get such diversity of opinions and actions, for do not each district or body of people get exactly that which they deserve?

The same with limited liability companies. The directors are of a certain type, they appoint officials for prescribed duties, which in turn are carried out in varied detail by others that they engage.

Generally speaking, according to the characteristics of the heads of the company, so will the entire staff and workpeople follow suit, for "human nature" has a way of gathering together affinities of varying degrees in evolution.

In the past "capital" dominated "labour," and we are now witnessing with the advent of increased—so-called—education, a struggle for mastery as between those forces. The workman's *morale* has not advanced in line with the educational facilities given him, neither has the employer realised that labour can have brains.

How many people act up to the belief, even if they think it, that there is no middle course as between advancing and receding; that what we think to-day, we act to-morrow?

My experience with "premium and piecework" systems does not give me much hope for their success, for I have never yet come across any employer who has been satisfied that it is fair to him, if his employés are content, and likewise *vice versâ*. I am absolutely convinced that the best system to adopt is day work with proper supervision.

If the employers would only appoint managers, foremen and under foremen who are not only masters of their work, but have sufficient "education" to be with the men and yet not of them, leaders who would scorn to "bully," but would encourage the men in their work, not only for the wages they receive therefrom, but for the pleasure of overcoming difficulties, and doing their best in whatever they may be engaged upon, success would be theirs. There are plenty of men to worthily fill these positions, if only the employer wanted them.

Some professors can make their students feel that they are with them; many never get in touch, because they know nothing of life beyond their immediate study.

Technical institutes are training our lads in the right direction up to a certain point, but beyond that they are dismal failures. Theory is necessary, but without practical experience it is useless, and every lad should have some years in the workshop, mixing with the men, and gaining a thorough insight into the work that lies before them.

All cannot raise themselves up to the higher positions, but it ought to be possible for a lad who showed special aptitude in his work to be able to combine work with study, for very few can work all day and study at night, they require a change if they are to grow up well-balanced men.

The old type of employer who mingled with his men, giving words of encouragement here, and advice there, is dying out with the advent of L. L. Co.'s, Trusts, &c., but there is no reason why the same spirit should not live on.

Let the employer and employé obtain a higher education in human nature, try to solve the problem why the hand-

shake of one is repugnant to the other; how the presence of one person can upset the pleasures of a whole company; a single glance can make for enmity or friendship. Very few employers relish having a man in their employ who speaks that which he knows to be right, even when spoken in known sincerity and courtesy, preferring rather the man who will fence or pander to their own, so-called, ideas and opinions.

Such being the case, is it to be wondered at that the men do not always do that which they feel to be right? For with all the "independence" of the average man, he is very fond of imitating his "superiors."

As a member of an association who meet for mutual advancement, I am often painfully surprised to find how few look beyond their immediate surroundings and feel it to be a duty to improve themselves, not only for their own sake, but for that of the community at large.

The younger generation appear to see these axioms, even if dimly; cannot the lesson be taught? Until the community at large realise that we are all akin, and treat each other as man to man, each one doing his best in whatever position he may be placed, leave off apeing that which we are not, and generally saying what we mean, and doing what we say, then, and not until then, will each receive his due reward, feeling that life is worth living, because their conscience tells them that they have done unto another that which they would have done unto themselves.

A. A. D.

Insurance and Consulting.

I have been expecting to see in the Review a reply from the writer of the book "Electrical Motor Installations," which you criticised in your issue of the 16th ult., or by the insurance company on whose behalf the book appears to have been written to serve as an advertisement.

The insurance company advertised in the book referred to is not the only one which has a consulting department, as I could name two others, and yet the canvassers of these companies have the audacity to call upon *bonâ fide* consulting engineers to obtain the insurance of boilers, engines, dynamos, &c., which the latter may have in hand.

Only a few months ago I was given, by one of my clients, a letter of introduction to a large firm contemplating electrical work, and upon calling I was informed that the consulting work had been given to the —— Insurance Co.

Only last week I was informed that the same insurance company had sent out specifications for some work in Ireland, and after obtaining one or two tenders from local Irish firms, the contract was eventually given to an English firm of contractors, whose offices are in the same city as the insurance company.

Consultants have for some time past had to compete with architects who seem imbued with the idea entertained by the worthy Southwark councillor that "electricity can be learned in a month," and now the boiler insurance companies have entered the field.

These companies, no doubt, owing to competition, find that they must have more strings to their bow than purely insurance, but is it not against a client's interest to employ them for consulting work, as the latter must feel morally bound to give them the insurance of the plant?

I do not see how the council of the Institution can stop them obtaining consulting work, the only method seems to be for a sound fire insurance company to take up insurance of electrical machinery, who would be assured of the recommendations of consulting engineers, and, no doubt, contractors.

I trust that you will not let the matter rest where it is, and hope that some steps may be taken to stop this unfair competition.

Consultant.

P.S.—Some time ago I noticed in a certain town, painted on the window of an architect's office: "X. Y., Architect, Surveyor, Estate Agent, Civil, and Electrical Engineer!"

[How can it be stopped? At present there is nothing to prevent any individual whatever from posing as a consulting engineer, regardless of his technical ability. The medical, legal, and accounting professions have their recognised ruling bodies, whose censure entails professional ruin, and is respected accordingly, but the engineering profession has no such controlling authority. Unless and until the Institutions of Civil, Electrical and Mechanical Engineers take sincere and active steps to purge their ranks of the many members who have transgressed the rules of professional conduct, the abuses in question will remain, and the profession will still be recruited from the ranks of the failures in other branches.—Eds. Elec. Rev.]

Corporation "Cheek."

We have received this week a typewritten circular letter from an enterprising borough electrical engineer asking us to quote for the fitting-up of an installation for some new corporation buildings; the letter stated that the engineer, owing to ill-health, was prevented from drawing up a specification, but asked the contractors to embody what they considered necessary in their tender, which must be sent in as soon as possible.

We sent an engineer over to take all particulars, and to our surprise found the "installation" required, for which circulars had been issued inviting tenders, consisted of *three plain pendants and one wall plug*, to be lighted from the Corporation supply, in some new stables.

We can only congratulate the ratepayers of this corporation on having a governing body which has the cheek to put probably a dozen contractors to an expense of from 10s. to 20s. for an estimate, the total amount of which could not exceed £4.

Contractor.

Electrical Engineering as a Profession.

If electrical engineering is to be regarded and recognised as a profession or occupation of any social status, requiring educational as well as laboratory and station-work training, is it not time that steps should be taken by the Institution of Electrical Engineers, as representing the profession, to institute a qualifying standard, or some system by which qualifying certificates could be given to men who can show that they have had an efficient educational and electrical training, to admit of their styling themselves as electrical engineers, and to give them the right of writing the letters E.E. after their names. I am sure that, if this were done, the public would give courteous recognition to the profession by styling qualified men as electrical engineers, or by writing E.E. (electrical engineer) after their names, in the manner of address given to civil engineers. A register of qualified men could be kept, and by this means the public would be secured against the dangers that are being constantly incurred owing to the employment of unskilled electricians. There could be no doubt either that employers, such as borough and urban councils, large companies and others, would be in pocket every year if they were to employ only competent men and pay them adequate salaries, as by doing so many costly break-down accidents and damage to electrical appliances would be avoided by skilful foresight and handling.

The salaries paid to charge or shift engineers at the present time are absurdly inadequate, considering the responsibility they are placed under during their long hours of duty, and, indeed, I know of no occupation in which men are more tied throughout the year than charge engineers—Christmas, Easter and Bank Holidays being shut-up days for them. I blame borough and managing engineers for the small salaries that are paid to charge engineers, as it is they who should have the manliness and fairness to point out and explain to borough councillors and employers that it is false economy to expect qualified men to work and take proper interest in their duties for poor pay. The majority of borough engineers are very much underpaid; but how can they expect better pay themselves while they ask their assistant engineers to work for so little? It is only too well known that some borough engineers cut down the salaries of their assistants and others for the mean purpose of gaining credit for themselves by making it appear that they are effecting economies by good management. It is a

fact, too, that not a few of the chief engineers forget themselves so far, or are so wanting in good manners, as to treat their assistant engineers with but little civility—looking down upon them, instead of treating them as their own equals professionally. Officers of the Army and Navy and the members of other professions treat each other as equals professionally and from a social point of view as well.

If I remember rightly, it was Lord Kelvin who said a few years ago, at a gathering of electrical engineers, that the profession was being ridiculously underpaid.

In conclusion, I wish to say that if electrical engineering is to be looked upon as a profession, it is most desirable that only properly-trained and well-educated men be given the positions of chief and charge engineers.

R. B.

October 11th, 1904.

The Value of Education.

I was pleased to read "University Lecturer's" remarks in last week's issue, and note with interest that both he and A. Jamieson, M.I.C.E., confirm my remarks regarding overwork in evening classes.

Everyone knows, of course, that the evening student is excessively zealous, and this often defeats its own ends by damaging health. Often a student would do better by attempting less, or even reading "Clydeside Echoes."

Many things can, of course, be learned in evening classes; but it frequently amused me to see a student attempting to master in one night's laboratory work "The Use of the Silver Voltameter," or "Wheatstone Bridge." He obtains knowledge, certainly, but not scientific knowledge. The worst of it is, that the student thinks he knows all about it when he leaves the laboratory, having obtained "a result," and eventually suffers from "swelled head."

Many subjects, no doubt, can be taught by correspondence; but without the laboratory, what does a student's knowledge of physics or chemistry amount to? Of course a student may pass an examination in, say, physics, with, perhaps, little or no laboratory experience; but this merely shows that the method of examination is at fault.

It is a great pity, as A. Jamieson points out, that many of our "captains of industry" have only a meagre scientific training, derived from evening classes, &c. That is just the reason why Southwark aldermen think scientific knowledge can be "picked up" very rapidly, and fully accounts for the decay of many of our industries involving scientific application. It would be better for this country if the "captains of industry" were graduates.

"Evening Student" is somewhat loud in his praises of evening classes. Why, then, does he suggest taking a day course at all, if so much can be "picked up" at night? Perhaps he will kindly explain this difficulty—if he can.

Graduate.

I have read, with great interest, the various letters appearing in your excellent journal on the above subject.

That correspondence tuition may be of great benefit to students who, for various reasons, are compelled to live in small towns, or in districts where there are no efficient technical schools, is undoubted. There is one question, however, concerning that system that none of those advocating it ever seem to refer to, and that is, the eminently practical one of the value of the certificates granted by these institutions, and whether they carry any weight with employers. This point is of importance when the student is applying for a situation.

F. C. S.

Your several correspondents have either cordially agreed with or entirely disapproved of my remarks concerning the money value of education. In every case I have to thank them for their obvious earnestness and the kindly manner in which they have expressed their views.

"Commonsense" hits the nail on the head. We ought to have for responsible positions ashore something similar to the Board of Trade marine "tickets."

I am no believer in correspondence schools. Clearly the *character* of the student is not affected by them. Prof. Jamieson offers us a rushlight for to illuminate the heavens. Tuition by correspondence, despite the alluring advertisements, is after all a feeble if not dangerous way of imparting knowledge. I do not attack Prof. Jamieson's system, which of its kind may be the most efficient. Nor do I doubt but that Prof. Jamieson is other than justly proud of those pushful and ofttimes veneered students-by-post who will probably reply to my condemnation of such methods. As a last resource such schools may do.

> **Wisdom from the mouth of children surely should be scoffed by none,**
> **What man scorns to walk by lamplight in the absence of the sun?**

Where it is possible, let us give our engineers a liberal education. Let them also understand that the blessing of human society is denied them by such methods as some would adopt.

A University Lecturer.

Inquiries.—A correspondent wishes to know the name of the makers of the "Etampé" type of accumulator.

Another correspondent writes:—"Can you put us in communication with anyone supplying a device for the prevention of lamps being removed from holders by any but those responsible?"

BUSINESS NOTES.

Electrical Wares Exported.

Week ending October 13th, 1903.

Adelaide		Value £81
Alexandria		21
Amsterdam		128
Auckland		94
Calcutta		1,262
Cape Town		3,049
Delagoa Bay.	Teleg. mat.	1,267
Durban		1,323
"	Teleg. mat.	149
East London		240
Fremantle		165
Hong Kong		33
Lyttelton		105
Melbourne		277
Montreal		36
Perth		63
Port Elizabeth		169
Rangoon		55
Rotterdam		23
St. Petersburg.	Teleg. mat.	100
Shanghai		391
Singapore		20
"	Teleg. mat.	16
Sydney		242
Townsville.	Teleg. mat.	850
Venice		110
Wellington		124
Yokohama		240
Zanzibar		83
Total		£10,666

Week ending October 11th, 1904.

Alexandria		Value £117
Amsterdam		57
Bangkok		28
Beira		15
Bombay		250
"	Teleg. mat.	44
Bordeaux		44
Bremen		35
Brisbane		34
Calcutta		666
"	Elec. cable	1,351
"	Elec. machinery	425
"	Teleg. mat.	162
Cape Town		14
"	Elec. machinery	1,150
Durban		609
"	Elec. machinery	335
"	Teleg. mat.	130
East London		247
"	Elec. machinery	84
Fremantle		1,114
Gibraltar		986
Gothenburg		65
Hamburg		25
Hong Kong		13
Le Treport		45
Malta.	Elec. machinery	2,960
"	Teleg. mat.	28
Monte Video		78
Perth		607
"	Elec. machinery	491
"	Elec. cable	646
Port Elizabeth		33
Rangoon		10
Rio Janeiro		135
"	Elec. machinery	500
"	Teleg. mat.	165
Rotterdam		15
Santiago		41
Singapore		80
Sydney		572
Tokio.	Elec. machinery	544
Trinidad		86
Wellington		167
"	Elec. machinery	189
"	Teleg. mat.	728
Yokohama		319
Zanzibar		19
Zarate		170
Total		£16,744

Foreign Goods Transhipped.

New York.	Elec. apprts.	Value £92
Boulogne.	Elec. mat.	Value £32
Durban.	Elec. apparatus	296
Melbourne.	Elec. lamps	105
Rotterdam.	Elec. appliances	25
Wellington.	Elec. goods	40
Total		£498

Liquidations.—A meeting of the Stewart Electrical Syndicate is to be held at 140, Leadenhall Street, E.C., on Thursday, November 17th, to hear an account of the winding-up from the liquidator (Mr. Geo. S. Pitt).

A similar meeting relating to the Electrical Indicator Syndicate is to be held at 4, Pembroke Street, London, N., on November 15th (Mr. H. Breeze, liquidator).

The Shoreditch B.C. Electrical Exhibition.—An electrical exhibition, held under the auspices of the Shoreditch B.C., was opened by the Mayor, Councillor H. B. Bird, J.P., on the 10th inst., at the Pitfield Street Baths, Hoxton. It is an excellent municipal exhibition, and worthy of a visit from those who are power users, to inspect the many working exhibits, demonstrating the manner in which electric motive power can be adapted for driving purposes to all manufacturing trades. Shoreditch is, as Mr. C. Newton Russell stated at the opening ceremony, essentially a manufacturing district—the wood-working industry being particularly strong there, and there are several good exhibits appertaining to this trade. Messrs. Isenthal & Co., of 85, Mortimer Street, W., show their specialities in the way of electric glue pots for cabinet makers, &c, electric melting pots for soft metal, electrically-heated soldering bits for the tinning trades and various electrical cooking and heating apparatus, stoves, &c. The Crypto Electrical Co., of Bermondsey Street, S.E., display several small dynamos and motors, D.C.—A.C. motor-generators, and semi-enclosed motors. Messrs. A. W. Penrose and Co., of 109, Farringdon Road, E.C., exhibit a 1-ton electric goods lift equipment, and a 2-ton warehouse crane, a combined power and lighting switchboard, motor-driven saw, cooking apparatus, &c. Messrs. H. F. Joel & Co., of 31, Wilson Street, E.C., show an electrically-driven band saw and "Zone" motors; these motors have been very fully described and illustrated in a recent issue of the Review. Messrs. Crompton & Co., Ltd., exhibit motors from ¼ to 10 H.P., ceiling fans, arc lamps and various measuring and testing instruments. Messrs. Humpage, Jacques & Pedersen, Ltd., of Ashton Gate, Bristol, show their speed reducing gears for electric motors, and a self-contained electric sack hoist. The General Electric Co., Ltd., are well represented with an exhibit of telephonic apparatus, motors, cooking utensils, instruments and electrical accessories generally, and the Robertson Electric Lamp Works have a separate stand showing the manufacture of incandescent lamps, the bulbs being blown and shaped at the exhibition. Messrs. Marryat and Place have on view at their stand, or in various parts of the exhibition, a complete range of all the smaller sizes of "M.P." motors from ½ H.P. to 15 H.P., and motor starters, ironclad switches, fuses, &c. Messrs. J. Sagar & Co., Ltd., of 60, Watling Street, E.C., show electrically-driven wood-working machinery; the Electromotor and Dynamo Co., motors from ½ H.P. to 20 H.P., and controllers for hoists; E. P. Allam & Co., electrical accessories; Messrs. F. W. Potter & Co., a 6-H.P. "Wing" motor, coupled to a Worthington pump, and others as adapted for laundry work, and fans, &c. The Brockie-Pell Arc Lamp Co., at their stall, display their arc lamps, a 90-ampere projector lamp, differential cut-outs, &c. The Lister Electric Manufacturing Co. have various electric motors, one of which is coupled to a "West" ice-making and cold storage machine. The Electric Welding Co., Ltd., of 28, Basinghall Street, show in operation one of their automatic electric welding machines. The Reason Manufacturing Co., Ltd., of Brighton, are present with electricity meters, electrical clocks, miniature arc lamps and accessories. Messrs. Reed's Electrical Engineering and Supply Co., of 128, Southwark Street, S.E., exhibit a $\frac{1}{10}$-H.P. motor operating a sewing machine, a tailor's electric cutting machine, the motor being complete with the machine, also electrical accessories. Messrs. Nalder Bros. & Thompson, of 34, Queen Street, E.C., show a "Drysdale" patent indicating wattmeter, portable combined testing sets and measuring instruments, &c. The Electric Construction Co., of Wolverhampton, exhibit a motor driving a mortising machine, small rotary converter and an electrically-driven portable drill, and the Phœnix Dynamo Manufacturing Co., Ltd., of Bradford, also exhibit a portable electric drill. Electrically-operated pianos are also shown by Messrs. Elman Bros. & Co., of 159, Whitechapel Road. Amongst others exhibiting are the following: Messrs. J. Defries and Sons, Ltd., Messrs. J. S. Henry, Ltd., wooden electric fittings; Messrs. Matthews & Yates, Ltd.; Linotype and Machinery, Ltd.; The Simplex Steel Conduit Co., Ltd.; Messrs. Royce, Ltd.; Messrs. W. T. Glover & Co., Ltd.; and Messrs. Babcock & Wilcox, Ltd. Demonstrations with wireless telegraphy by the General Electric Co. will be made in the hall each day. The exhibition will remain open until the 22nd inst., and the price of admission is 2d.

Electricity in Collieries.—The introduction of electricity into collieries in the North of England is making considerable progress, and we are informed that Messrs. Ernest Scott and Mountain, Ltd., have recently secured some important contracts. For the Dunston, Swalwell, and Garesfield Collieries, Ltd., they are to supply a complete plant equipment for the surface and underground, the power for which will be supplied by the Newcastle-on-Tyne Electric Supply Co. On the surface there will be an electric winding gear, fitted with a three-phase motor capable of winding from a depth of 200 ft., the motor being fitted with a special controller, so that the speed of the winding can be varied, and also run at a very low speed if necessary for the examination of the shaft, &c. In addition to the winding gear, the fan, and an endless rope haulage gear, which are placed at bank, are also electrically-driven. The current is taken down the shaft by armoured cables, and at the shaft bottom a main shaft pump of Scott & Mountain's three-throw type is to be fixed, to deliver 1,200 gallons of water per minute against a head of 220 ft. In the five-quarter seam another electrically-driven pump will be placed, this pump delivering 200 gallons per minute at a distance of 1,000 yards in-by. In the Brockwell seam two further sets of Scott & Mountain's pumps will be placed, each of these sets being designed to deliver 300 gallons against a head of 105 ft. This is believed to be one of the first instances in the United Kingdom where the whole equipment of the colliery will be electrically driven and steam entirely dispensed with. For Messrs. Jas. Ross & Co., of the Philipstown Oil Works, Linlithgow, Messrs. Scott & Mountain have also secured a contract for three sets of their enclosed high speed three-crank compound engines for coupling to continuous-current dynamos; each dynamo will have an output of 200 KW. In addition to the generating machinery, Messrs. Scott & Mountain have in hand for Messrs. Ross two sets of endless rope haulage gear, to be driven by 75-H.P. electric motors, and also a complete equipment of the machinery at bank, including a ventilating fan, shale-breaking machinery, mortar mill, shale haulage, and stable and workshop machinery. The same firm have in hand for Messrs. Bell Bros., Ltd., of Port Clarence, a compound horizontal engine, with generator mounted on the crankshaft. This plant is of 650 I.H.P., and the generator is being constructed to give an output of 400 KW. They have also secured an order for a similar generator mounted on the crankshaft on an existing engine. In addition to the above, we also understand that Messrs. Scott & Mountain have a large amount of work in hand, including an air compressor for the Wigan Coal and Iron Co., Ltd., considerable extensions to the electrical plant for the Tredegar Coal and Iron Co., Ltd., which they put down about three years ago, and also coal-cutting machinery for Consett Iron Co., Backworth Colliery, Hamsterley Colliery, Thorncliffe Colliery, and many other important firms.

The Continuous Concrete Conduit Co.—By the courtesy of the borough electrical engineer, Messrs. Berry, Skinner and Co., of 78, Upper Thames Street, E.C., who control the Continuous Concrete Conduit Co., held a demonstration of duct making on that system, at Poplar, on October 7th. Already over 100,000 duct feet have been laid in connection with the Poplar electricity department, and since we originally described the system, at that time being put down in the Neasden power station of the Metropolitan Railway Co., great progress has been made in its use. For those of our readers who did not see our previous Note, we append the following brief description of the method of construction:—First, a layer of concrete is laid in the bottom of the trench. Light steel pipes which have been coated with special waxy material, are screwed together in desired lengths and laid as mandrels in rows upon the concrete bed in correct position and alignment. Concrete is then rammed between the mandrels and a further layer of concrete provided ready for the next row of mandrels until the requisite number has been installed. The earth is then put back and the next section of the work proceeded with in a like manner. As soon as the concrete in the first section is set the mandrels are withdrawn. Steam from a portable boiler is passed through the various mandrels in succession. The insulating mixture (which has a very low melting point) begins to melt in the course of a few minutes, when the steel pipes may be withdrawn by means of a winch, being unscrewed in sections as they come out, and leaving the special mixture (of a highly lubricating nature) around and at the bottom of the duct. While it was at first only claimed that a length of 180 ft. could be conveniently withdrawn at one time, it has been placed on record that a length of 225 ft. has been satisfactorily withdrawn during the progress of the work at Poplar, the total distance between manholes in this instance being over 150 yards. It is curiously characteristic of the system, within limitations up to about 60 yards, that the longer the length of piping to be drawn out, the easier becomes the process of withdrawal. When the pipes have been removed they are again ready for dipping into the lubricating bath, from which time forward they undergo an alternate process of burial and resurrection until the work is completed. The demonstration was attended by many well-known representatives of the electrical profession; and it would appear that the system offers many advantages over previous ones, not the least being a saving of at least 20 per cent. on first cost.

Australia.—The Australian Customs authorities have given a decision to the effect that "Electrical machinery rheostats are auxiliaries and not integral parts of appliances or machines," and are to be classified as "electrical materials" and admitted free of import duty.

Catalogues and Lists.—The Dominion Belting and Mill Furnishing Co., of 12, Colonial Avenue, Minories, E.C., have issued a circular relating to their "Nut-tan" improved compressed hide belting, which they are placing before the notice of electrical engineers just now.

Messrs. John Davis & Son (Derby), Ltd., have issued a new catalogue detailing their drawing office requisites, slide rules, &c. Numerous illustrations and prices are given.

Erith's Engineering Co., of 70, Gracechurch Street, E.C., have brought out a new catalogue (No. 151) in which full details of their patent underfeed stokers are given. A number of photographs appear, showing the application of the stokers in various works. Erith's automatic hot-process purifier is also shown.

Pamphlet No. 175, issued by The British Thomson-Houston Co., Ltd., deals with their two and three-phase induction motors, giving a full illustrated description of the general design and construction of the motors, also a table of dimensions and weights.

Belgium.—The balance-sheet of the Compagnie Electrique Anversoise, of Antwerp, for the last financial year shows a profit of £22,660, as compared with £18,240 in the preceding 12 months.

Book Notices.—Messrs. H. F. Parshall and H. M. Hobart have in hand a new and important work on "Electric Traction" of an exhaustive nature, which will shortly be published by Messrs. A. Constable & Co.

"Journal of the Institution of Electrical Engineers." Vol. 33, part 6, September, 1904, price 4s., and "List of Officers and Members of the Institution of Electrical Engineers." London: E. & F. N. Spon.

"Electric Furnaces and their Industrial Applications." By J. Wright. London: Archibald Constable & Co. 8s. 6d. net.
"Smoke Prevention and Fuel Economy." By Wm. H. Booth and J. B. C. Kershaw. London: Archibald Constable & Co. 6s. net.
"The Testing of Continuous Current Machines." By Charles Kinzbrunner. London: Harper Bros. 6s. net.

Trade Announcements. — The Electric and General Stores Co., of Leeds, announce that, owing to the development of business at that branch, they have removed to more commodious premises at Commercial Chambers, 104, Albion Street, Leeds, where all future communications should be addressed. Larger stocks will be kept, and a showroom of electrical fixtures has been opened.

The Humboldt Engineering Works Co., of Kalk, near Cologne, announce that from October 1st, Mr. Mount-Haes, M.I.Mech.E., has taken over their London agency, and has moved the offices from 37, Walbrook, E.C., to 11, Ironmonger Lane, E.C. Mr. H. J. A. Herrmann, M.I.M.E., who has hitherto held this appointment, has left to assume the position of chief of the English department at the works in Kalk. The electrical contracting business hitherto carried on by Thomas Gradon, jun., at 131, Barras Bridge, Newcastle-on-Tyne, has been transferred to Messrs. Robson & Coleman, electrical engineers, of 5, St. Mary's Place, Newcastle-on-Tyne.

British Schuckert Electric Co. v. Lurgan Weaving Co. —In the King's Bench Court, at Dublin, on the 5th inst., the British Schuckert Electric Co. sued to recover £119 for electric plant sold and delivered to the Lurgan Weaving Co., Ltd., of Lurgan. The defendants had lodged the £119 in court, and counter-claimed £100 damages for delay. The plaintiffs alleged that there was no delay on their part. Mr. John M'Gonigal, on behalf of the plaintiffs, moved for an order that defendants do make an affidavit of the documents in their possession or power relating to the matters in controversy. Mr. Justice Boyd made the order sought.

LIGHTING AND POWER NOTES.

Australia.—An Australian contemporary states that steps have been taken to obtain the requisite order-in-council for the lighting of the town of Hamilton by electricity.

Electric light has also been installed in the township of Leongatha, Gippsland. The promoters of the scheme were a local business firm, and the work was carried out by Messrs. Edmiston and O'Neill, of Melbourne. The generating plant includes a 28-H.P. "Simplex" kerosene engine coupled to a dynamo capable of supplying 200 16-C.P. lamps, in addition to six "Liliput" arcs of 160 C.P., erected under contract with the Council. The price paid by the Council for the latter is £6 10s. per annum.

Birkenhead.—The Electricity Committee recently intimated that a supply of energy to Upton would be commenced almost immediately.

Brandon.—The U.D.C. has resolved to ascertain whether any of the local colliery companies are in a position to supply energy for public lighting.

Crewkerne.—The U.D.C. has resolved to obtain advice as to the cost of laying down an E.L. installation in the town.

Dalkeith.—The T.C. has received intimation from Messrs. Crompton & Co. that the street lighting will be complete by January 1st, but the Council has replied that it desires, if possible, to have the work completed next month.

Earsden.—The U.D.C. has accepted the offer of the Backworth Coal Co. to supply electricity for 100 lights for the principal roads in Earsden and Backworth.

Egypt. — TANTAH. — The local correspondent of the *Egyptian Gazette* states that the Société Electrique de la Basse Egypte has erected three Crossley 60-H.P. gas-engines. At present one is sufficient for the lighting of the town, but space sufficient for the erection of two additional ones, when required, has been provided in the engine room. The number of lamps, he states, is not sufficient; 350 lamps of 16 C.P. have been put up, and the distance between some is 100 to 120 metres. "But what can the company do with an annual subvention of £800?" Negotiations are pending for the lighting of the railway station, and it is proposed to erect 100 16-C.P. lamps and 28 larger lamps of the same type as at Cairo Station, and to run one of the sets solely to supply energy for this installation.

SUEZ.—It was stated that on the 5th inst., the company which has the contract to supply electricity for lighting purposes in the district, would be ready to supply the town of Suez and Port Tewfik. The street lamps to be erected are of 25 C.P.

Farnborough.—The 1899 electric lighting order has been revoked by the B. of T.

Germany.—An electric lighting station is to be established in the town of Lochtum.

Gillingham, Kent.—Meter rents have been reduced by the Corporation from 2s. 6d. to 1s. 6d. per quarter.

Gorton.—The U.D.C., on the 7th inst., decided to hand over to the Manchester Corporation the Gorton electric supply order granted in 1899.

Grimsby.—The result of the year's working of the Corporation E.L. undertaking ended March 31st last was as follows:—

	1904.	1903.
Revenue, private lighting	£4,308	£3,211
,, public lighting	1,640	1,529
,, traction	2,723	2,870
,, sundries	416	188
Total	£9,087	£7,398
Total working costs, including public lighting ..	£4,548	£4,089
Interest	£3,492	£2,873
Sinking fund	£1,574	£1,936
Provision for bad debts	£54	£30
Loss on year's working	£581	£1,420
Inclusive average price obtained per unit	2·72d.	2·71d.
Total works cost per unit	1·36d.	1·5d.
Total number of units sold	799,602	653,438
Maximum load recorded	542 KW.	508 KW.
Total capital expended	£78,287	£71,837

Hebden Bridge.—The U.D.C. electricity works, costing £10,260, were opened on 6th inst., the ceremony being performed by the chairman of the Council, and in connection with this function an Exhibition was held showing the various applications of electricity for driving purposes, &c. The scheme has been carried out under the advice of Mr. Walter Emmott, of Halifax.

Ilkeston.—The Mayor (Ald. C. Maltby, J.P.) on 3rd inst. opened an electrical exhibition, held in a large marquee erected in the Market Place; the exhibition was organised by the Tramways and Electricity Committee of the Corporation. There were on view and in working order electrical coal cutters, a wireless telegraph installation, dynamos, motors, electrical drills, colliery fuses, fans, arc and incandescent lamps, switchboards, main cables, submarine cables, and various kinds of automatic meters, fittings, and brakes. Demonstrations of glass blowing, lamp making, &c., were also given. The Corporation exhibit consisted of various earthing devices for avoiding accidents by leakage of electric current from cars, automatic time recorders for trams passing certain points, signalling apparatus, &c.

Ipswich. — The accounts of the Corporation electrical supply department have just been issued, and the results for the working of the undertaking from November 21st, 1903, to March 31st last, are as follows:—Revenue: By lighting and power, £659; traction, £1,782; sundries, £21. Expenditure: Total works costs, £2,109, leaving a balance of £354. The amount set aside to interest is £2,037, and to repayment of loan, £481, resulting in a deficit on the four months' working of £2,163. To meet this, £1,421 has been applied from the rates and the balance carried forward. The total capital expended to March last was £56,870. The number of units sold amounted to—lighting, 28,597; traction, 213,875; total, 242,472; and the maximum load recorded was 390 KW.

Italy.—A concession has been granted to put down a water-power plant on the River Lorenza Madonna, at Briga Marittima (Cuneo), for generating electrical energy.

London.—MARYLEBONE.—Mr. Wilkinson, the newly appointed resident electrical engineer, is to partially commence his new duties at once, and is to be paid half salary until his notice of resignation to the Walthamstow Council expires. At the meeting of the B.C. on 13th inst., the Finance Committee presented a report dealing with the proposed loan of £1,415,000 required for the purchase of the electric lighting undertaking. A mortgage of the general rate was to have been sealed to secure the loan from the L.C.C.

ISLINGTON.—The B.C. has sanctioned the estimates of £977 for 12 combined feeder pillars and arc lamp columns, and £200 for mains extensions. A proposal to borrow £33,026 for E.L. purposes from the ratepayers, in small amounts, has been referred to the Finance Committee, with power to act.

PATTERSEA.—The B.C. has decided to expend the sum of £125 in fitting up the meter-testing room at the generating station to enable meter repairs to be carried out by its staff. The public lighting mains are to be extended in the borough, and Nernst lamps provided at an estimated cost of £942. The charge for supplying energy to these lamps when erected, has been fixed at £6 each per annum.

Loughborough.—The erection of the municipal electricity works is now almost completed, and in the course of a few weeks it is stated that a supply will be available. The plant consists of two "Danks" dry back boilers, with superheaters and economiser, and a storage tank of a capacity of 15,000 gallons; two Brush turbo-generators of 250 KW. capacity, and a Siemens balancer-booster are to be installed, and a storage battery of 260 cells, giving 250 amperes for 10 hours.

Lowestoft.—A L.G.B. inquiry was held last week into the application of the Corporation to borrow the sum of £3,600 for the purchase of property in connection with the E.L. undertaking.

Newport.—Mains extensions in the Mainda district have been decided upon, and the electrical engineer will report as to certain other districts being lighted by electricity.

Oulton Broad.—The U.D.C. has come to an arrangement with Messrs. Barber & Croft, who are supplying energy in the district, that neither the Council nor the company shall for a period of five years apply for a prov. order unless such powers are applied for by some other company.

Radcliffe.—The electricity works were formally opened by Mr. J. H. Lund, chairman of the Electricity Committee, on the 5th inst. The Council has been supplying energy for lighting

purposes since June last, but it is only recently that the tramway supply has been completed. The works are to supply energy to the Bury Corporation for the tramway routes in the district.

The Scottish Central Electric Power Co.—This company some time ago was granted a prov. order for the supplying of power and light to certain districts, and has now made a beginning with the erection of the generating station. The site lies about equidistant from Larbert, Bonnybridge, and Denny, and covers about five acres. The radius of supply will be about 12 miles Messrs. Bramwell & Harris, of Westminster, are the consulting engineers, and the builders are Messrs. J. J. & P. McLachlan, of Larbert.

Spain.—A company has just been formed in Bilbao with a capital of £7,200, and it is proposed to put down a water-turbine plant on the River Leza (Logrono) for generating electrical energy.

Stratford-on-Avon.—The T.C. has resolved to enter into negotiations with the Birmingham Installation Co., with a view to an arrangement with it for installing the electric light in the district, subject to the sanction of the B. of T., and of transferring to the company the Council's prov. order.

Surbiton.—The District Council on the 10th inst. sealed a supplementary agreement with Messrs. Callender for an extension of the electric light to Tolworth. It was reported that up to date there had been expended on the undertaking £47,015 (£7,208 on buildings and site, and the balance on machinery, mains, &c.) The total number of consumers was 184, and the number of lamps fixed was equivalent to 11,001 of 8-c.p.

Sutton Coldfield.—The T.C. has resolved to install a high-speed steam generator and other machinery at the E.L. station at a cost of £3,800.

Sydney, N.S.W.—The half-yearly meeting of the Empire Electric Light Co. was held on August 27th, when the report for the six months ended June 30th was adopted. The net profit for the six months, together with £480 brought forward, amounted to £2,736, and after the declaration of a dividend at the rate of 6 per cent. per annum, and adding £1,000 to reserve fund, there remained £986 to carry forward. The chairman, Mr. Robert Imray, stated that in order to cope with the demands now in hand and contemplated, they had ordered further plant, which will be installed early in the coming year.

Walsall.—The Corporation electrical engineer has been instructed to report upon the cost of further extending the mains for public lighting.

Wilmslow.—The T.C. has decided to approach the Alderley Electric Lighting Co. to discuss the question of lighting the streets by electricity.

Wolverhampton.—The E.L. Committee has fixed the following scale of charges for energy for lighting as from July 1st:—Private lighting.—5d. and 2d., one-hour maximum demand. Large consumers: 3½d. per unit for a consumption of from 12,000 to 20,000 units per annum; 3¼d., 20,000 to 30,000 units per annum; 3d., 30,000 to 35,000 units per annum; 2¾d., 35,000 to 40,000 units per annum; 2½d., 40,000 units and upwards. Hotels and public houses, 2½d. per unit. And for energy for motive-power, 2d. and ¾d. per unit, first two hours' maximum demand. The electric mains are to be extended in Pountney Street and Stewart Street, at an estimated cost of £220, and they are also to be extended to the works of Messrs. Bayliss, Jones & Bayliss, Ltd., at an estimated cost of £645, that firm having entered into a contract with the Corporation for a supply of energy to their works.

The T.C. has received from the L.G.B. sanction to borrow £10,000 for E.L. purposes.

TRAMWAY AND RAILWAY NOTES.

Adelaide (S.A.).—From the *Sydney Daily Telegraph* we learn that the Premier stated in the House of Assembly about the end of August that the Government intend to appoint an electrical expert to report on the electrification of the tramways "before the acceptance of tenders" under the Bill now before Parliament. Some of the principal electrical firms in Australia protested against the appointment of Mr. Bradford, and they explain that their reason for so doing is not a spirit of detrimental opposition, but because they feel strongly that in a work of such an important character as that contemplated, an engineer should be appointed who is entirely independent of firms who might afterwards be asked to tender. It is impossible, they say, that an engineer who has been so long in the employment of one firm, and who at the time of his appointment to the position in question was still actually on the staff of that firm, should not be strongly biassed in favour of the designs and workmanship with which he is familiar.

Belfast.—At the meeting of the Corporation on the 3rd inst. no fewer than 11 deputations from trades unions were present to urge on the Council the necessity of having the conversion of the tramway, the building of rolling stock, &c., carried out by local labour, in consequence of the great depression in trade. It appears that 170 of the 240 cars required of the Leicester type, will be built by an outside firm, most likely, and the balance in Belfast. Specifications for the relaying of the permanent way are being got ready, the security for completion of contract being fixed at £15,000, whilst a penalty clause of £1,000 per week for non-completion within the specified period will be insisted on. To this the trades unions strongly object. It is understood that the Corporation, without binding itself, will do everything to further the employment of local labour.

At the monthly meeting of the Tramways Committee on the 10th inst., further deputations from trade societies were present to urge the giving of contracts to local firms. The consulting engineers, Messrs. Lacey and Sillar, of Lacey, Sillar & Leigh, were recently in the city preparing a report. The Committee is still considering the Kingsland mechanical surface contact system, a free trial of which has been offered.

Birmingham.—A broken trolley wire caused 35 minutes' delay in the traffic on the Bristol Road tramway system on 5th inst. It is thought the unevenness of the track, which causes severe swaying of the cars, may have been a contributory cause.

The Council has offered to run the King's Norton Council's trams, and hand over the whole of the net profits from its lines, but there is a tendency on the part of the King's Norton Council to treat with the Midland Tramways Co.

The draft of the new tramways Bill is down for consideration by the Council on 31st inst.

Black Country.—The new tramway from Old Hill to Blackheath, the cost of which to the Rowley District Council has been £28,000, has been completed, and the line has now been connected up with Dudley and Cradley Heath. The energy for driving the cars is to be supplied by the British Electric Traction Co., which has secured the lease of the tramways. It is hoped that the official inspection of the line will take place in the course of a fortnight, and that the cars will be running by the commencement of November.

Brandon.—The U.D.C. has assented to an extension of time to 1905 for the construction of the tramway by the B.E.T. Co., but has intimated that no further extension will be considered.

Bury.—The cost of the borough tramway undertaking was stated at the last meeting of the Council to have been £144,000. This includes the items of permanent way, electrical equipment, and street improvements. The amount is considered satisfactory in view of the fact that before the work was begun two Committees of the Council had inquired into the probable cost, one of which had estimated £204,000, and the other £186,000.

Bury, Rochdale, and Oldham.—The Heywood T.C. on Friday last decided to seal a conveyance of the undertaking of the Bury, Rochdale, and Oldham Tramways Co. to the various local authorities concerned. The arbitrator's award was for £160,000, and it was stipulated that the money should be paid by Saturday, October 8th, failing which it bears 5 per cent. interest. It was stated at the Heywood Council meeting that a cheque would be refused by the company unless it included the costs of the arbitration. These have not been, and cannot be immediately ascertained, and the company, it is said, declines to accept the local authorities' guarantee for them.

Chatham.—The appeal of the Chatham and District Light Railway Co., Ltd., against their rating was further considered by the Chatham Local Guardians on Monday. The matter had been left to Mr. Eve and the company's valuer to come to terms, if possible, without going to Quarter Sessions. The valuers met, and Mr. Eve (the board's valuer) forwarded his report, in which he provided for a reduction of the assessments to an extent of more than £600, chiefly on the value of the permanent way. After considerable discussion, it was decided to reduce the company's assessment from £932 on permanent ways to £338, the buildings remaining at £450.

Derby.—The difficulty between the T.C. and their tramway contractors has been settled. The contractors, Messrs. J. G. White & Co., Ltd., it was stated, had made themselves liable for penalties amounting to £28,032 by reason of delay in the completion of the works. At a meeting of the Council on the 5th inst., a decision of the Tramways Committee to accept £1,000 in satisfaction was approved. This sum the contractors are to deduct from their bill.

Falkirk.—Satisfactory terms have now been arranged between the syndicate who promoted the provisional order for the running of electric tramway cars at Falkirk and the company recently formed to take over the powers acquired by the syndicate; and it is fully expected that the work in connection with the tramway scheme will be begun in the course of the next month. The power for the tramways will be obtained from the Scottish Central Electric Power Co.'s new station, near Larbert.

Sheffield and Rotherham.—The Rotherham Town Council has approved the heads of an agreement with Sheffield for through tramway traffic between the two towns.

(*Continued on page* 623.)

SOUTH LANCASHIRE TRAMWAYS.

(*Concluded from page* 583.)

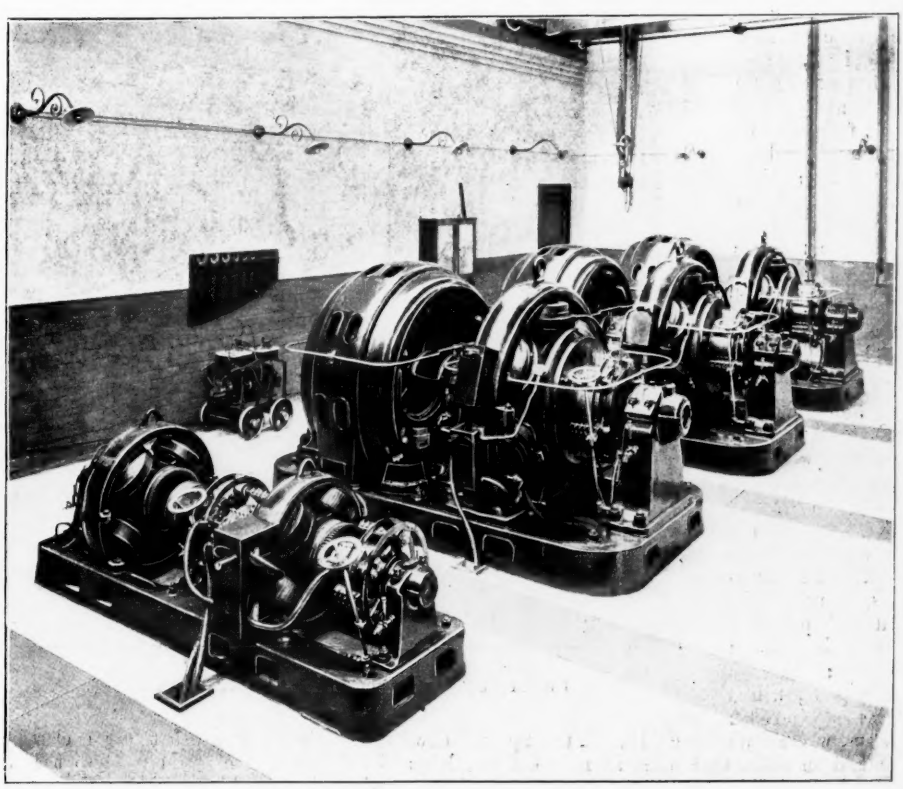
The high-pressure cables from the generating station to the sub-stations are of the three-conductor two-phase type, in

Storage Battery in Sub-station.

which two of the conductors are arranged as a twin cable, and the third, the common return, encircles them as an outer conductor, which is earthed at the central station. The same system, it will be remembered, has been employed by other users of extra high-pressure transmission also, as a convenient method of complying with the Board of Trade regulations, and minimising the cost of the cables. The chief drawback to it is, perhaps, the high potential difference set up between the two inner conductors, namely, over 10,000 volts. The main cables were drawn into Albion stoneware ducts, but most of the low pressure feeders are laid on the solid system in stoneware troughs. All the cables, including the three and five-core telephone and test cables, are insulated with paper and lead-covered, and were made and laid by the British Insulated & Helsby Cables, Ltd.

At present only one sub-station has been erected, in addition to that of the Atherton U.D.C. This is situated at Hindley, and consists of a brick building, lighted from the roof. The plant installed generally resembles the auxiliary plant already described in connection with the generating station, and comprises three 150-kw. motor-generators, positive and negative motor-boosters, a Thury reversible booster, and a milking booster, with Ferranti high and low pressure switchgear. Most of these are shown in the accompanying views.

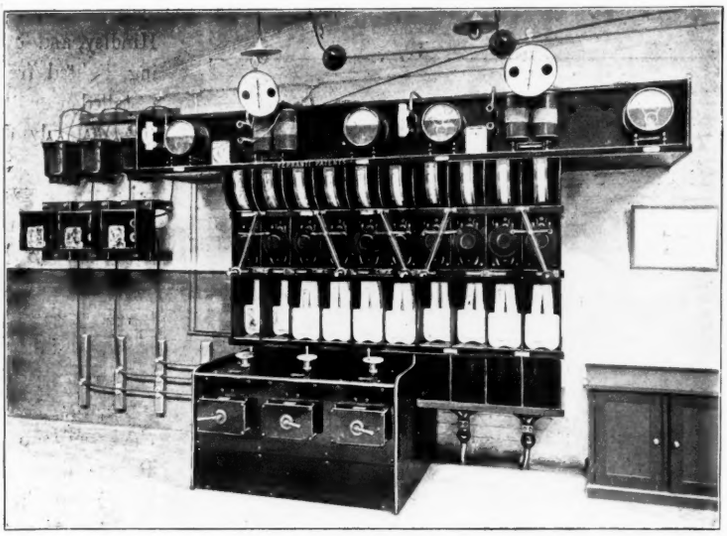
The motor-generators, which were made for Messrs. Witting Bros., the chief contractors, by Messrs. Kolben, of Prague, differ somewhat from the one installed at the power station, the two machines being mounted on a common bedplate and rigidly coupled together; also, instead of a separate switch pillar being provided, the equaliser and series cut-out switches are mounted on the yoke of the dynamo. The set runs normally as a shunt-wound dynamo driven by a synchronous motor, in conjunction with a Thury



General View of Transforming Plant.

reversible booster and a large battery; under these conditions the load on the motor-generator and feeder is kept

practically constant, the battery being automatically charged or discharged with the aid of the booster in accordance with the fluctuations of the traction load. It is needless to point out the economy resulting from the steadiness of the load on the sub-station, high-pressure feeder, and generating station, thanks to the use of the battery and booster system. As in the power station, when the battery is in use the generators are shunt wound, and maintain constant pressure on the bus-bars, the pressure on the out-going feeders being raised in proportion to the load by means of the positive feeder boosters. When, on the other hand, the battery is out of use, the generators are run as compound-wound machines.

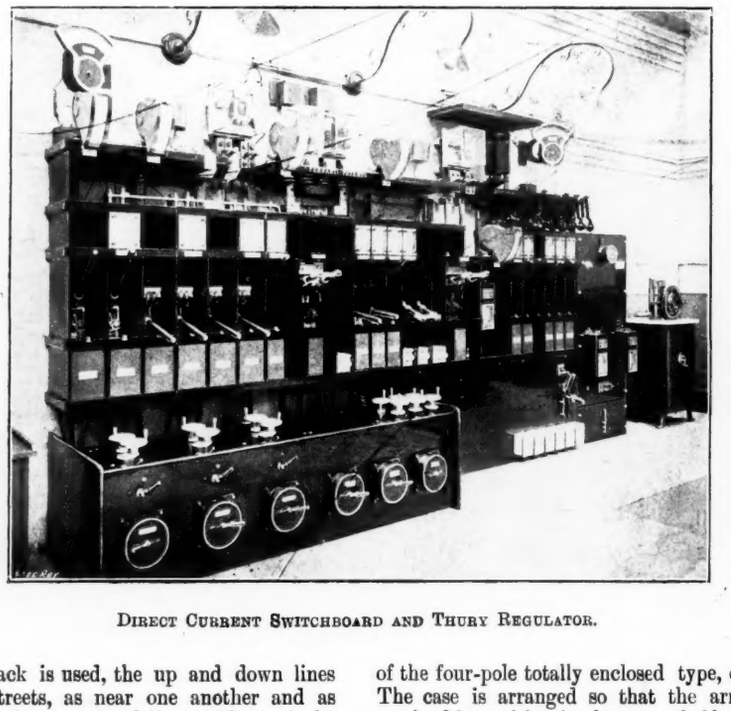


High Pressure a.c. Switchgear.

The high-pressure switchgear is all of the Ferranti standard pattern, providing for the two incoming extra-high-pressure feeders, which are brought to the bus-bars through fuses (one in each phase) and double-pole switches, and for the armatures of the three motor-generators, which are supplied direct from the bus-bars at 7,500 volts. Ammeters are inserted in circuit with the feeders, in each phase, with volt-indicators across the phases; ammeters, fuses, and D.P. switches are also provided for the motor circuits. Bus-bar voltmeters, synchronisers, and synchronising bus-bar voltmeters are provided in duplicate.

The low pressure D.C. switchboard also follows the pattern adopted at the power station, similar gear being used, including the Thury automatic regulator.

The battery, of which we give a view, consists of 240 Tudor cells, having a capacity of 500 ampere-hours when discharged at 83 amps. for six hours.



Direct Current Switchboard and Thury Regulator.

The tramways consist for the most part of single track with turn-outs, many of the routes passing through open country; in the busier parts, such as Atherton and St. Helens, where double track is used, the up and down lines are laid in different streets, as near one another and as parallel as possible. Owing to the different ideas of the various local authorities through whose districts the tramways pass, as to the correct way in which to make the roads, various kinds of track construction are in use, but the bulk of the track is laid on a concrete foundation, 6 in. thick and extending 18 in. beyond the rails on either side. The roads are paved with granite setts, grouted with pitch. The rails are of girder type, 6 in. deep, in 45-ft. lengths, and weigh 90 lb. per yd.; they are laid to a gauge of 4 ft. 8½ in.

The contractors for the track construction were Messrs. Krauss & Son, of Bristol; the special work at points and crossings, respectively, was supplied by Messrs. Hadfield's Steel Foundry Co., Ltd., and by Messrs. Askham Bros. and Wilson, Ltd., both of Sheffield.

The overhead construction was carried out by Messrs. R. W. Blackwell & Co., Ltd., with side poles and bracket arms. The trolley wire is of hard drawn copper, No. 000 B. & S. gauge, and the guard wires are of galvanised steel. Every second pole carries an incandescent electric lamp for lighting the roadway, this being undertaken by the company as part of its tribute to the local authorities.

The cars, 45 in number, were made by Messrs. G. F. Milnes & Co., of Hadley, with electrical equipments supplied by Messrs. Witting Bros., Electrical Engineers and Contractors, Ltd., of London. The cars are of the double-deck four-wheel type, providing seating accommodation for 55 passengers—33 outside and 22 inside. The interior is finished in oak and ash, with seats of perforated birch veneer; there are three large plate-glass windows on either side. The staircases are of the Milnes "Exhibition" type, which is much superior to the reversed stairway, as it avoids the confusion entailed by a descending queue of passengers meeting a crowd emerging from the door on the platform. Revolving destination-indicators are used, with headlights immediately beneath them. The trucks are of the Milnes four-wheel type. The car-bodies are 26 ft. 6 in. long over the platforms and 16 ft. over the bodies; the greatest width is 7 ft., and the wheel base is 6 ft.

The motors, one of which is shown open on p. 621, are of the four-pole totally enclosed type, of the latest pattern. The case is arranged so that the armature can either be retained in position in the upper half, as shown, by means of hooks embracing the grease boxes, or can be lowered in the bottom half of the case. The coils are all former wound, the field coils being held in place by the laminated pole shoes, while the armature coils are secured in the slots. Special attention has been given to the insulation of the end

connections of the latter. Each machine is tested with a pressure of 2,500 volts A.C. for five minutes after assembly. The motor is rated at 30 H.P., with a rise of 75° C. after one hour's run at full load. In actual tests, however, the temperature rise is considerably less than this, not exceeding 65° C. The motor is capable of standing 100 per cent. overload without sparking, and possesses a high efficiency at full load.

The controllers are also of Messrs. Witting Bros.' type, while the trolley standards and poles, with swivelling trolley heads, are of Messrs. Estler Bros.' internal spring type.

The main car-sheds adjoin the power station at Howe Bridge, and at present provide accommodation for 40 cars; they are capable of extension as required. The tracks are built on brick piers, so that the inspection pit extends over the whole area of the shed; a traverser is provided at the back end of the shed, and workshops are provided for repairing and painting cars, fitting and armature winding.

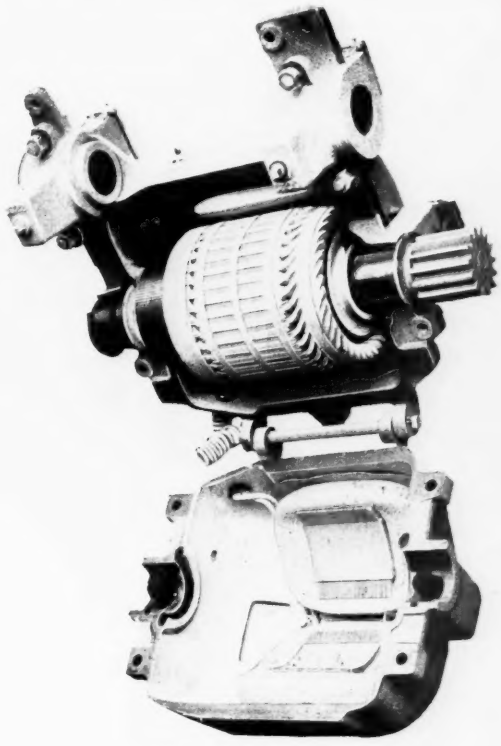
The car-sheds have been arranged contrary to the usual plan, the parallel tracks having been laid first, and only the part remote from the fan having been roofed over. Thus when extensions are required, the tracks will not need alteration, but the additional roofing will be erected over them. Whether this method will prove superior to the ordinary one remains to be found by experience.

There is an additional car-shed at Hindley, with accommodation for 30 cars.

The resident engineer and manager of the power station and tramways is Mr. E. H. Edwardes, whose chief assistant is Mr. T. Hayes; we are indebted to these gentlemen for invaluable help in the preparation of this article.

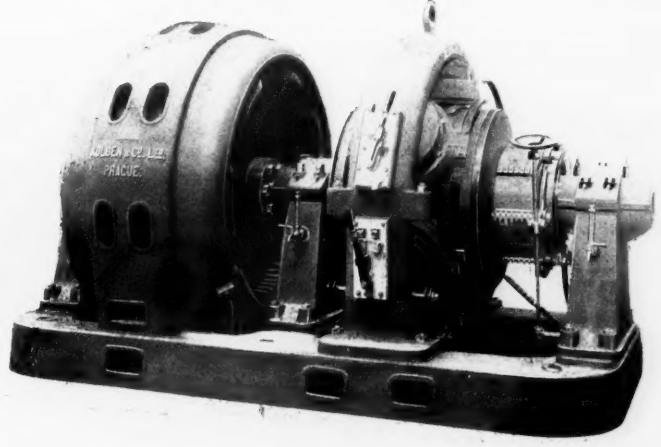
The head office of the company is at 9, North John Street, Liverpool, where all matters relating to administration, &c., are dealt with under the direction of Mr. J. R. Salter, engineer-in-chief, who is also manager of the St. Helens Tramway Co.'s system, over which the South Lancashire Co. has running powers. This arrangement ensures the harmonious working of the two systems, to the advantage both of the travelling public and of the tramway companies. The cars are supplied with power, whilst within the jurisdiction of the St. Helens Corporation, from the electricity works belonging to the latter; between St. Helens and Liverpool the tramway is known as the Liverpool and Prescot Light Railway, and is supplied with power from the Prescot electricity works. The Liverpool Corporation has entered into agreements with the South Lancashire and St. Helens Companies, whereby the cars of the latter are admitted into the city, being put in charge of the Corporation's drivers and conductors at the boundary, and *vice versâ*, each party paying the other the sum of 1d. per car-mile for the privilege. "Through" fares are provided for in the agreements, the journey between the Pierhead, Liverpool and St. Helens by tramcar costing only 6d., or about ½d. per mile. The South Lancashire Tramways also connect with those of the Bolton Corporation, but the latter refuses to exchange traffic regularly with the company, although through running has been tried for a time. We trust that, following the important precedent recently laid down by Parliament, insisting upon the interchange of cars in the Newcastle district, the South Lancashire Company and the Bolton Corporation will at no distant date be able to arrange terms satisfactory to both parties; for, where the gauges of the tramways are identical, no more unreasonable or unbusiness-like attitude could be imagined than that which prevents the residents in a district from travelling as far as they choose without changing cars. Moreover, Bolton lies across the authorised routes of the company, which run from Bolton up to Darwen, where they will meet the 4-ft. tramways of the Darwen, Blackburn, and Accrington Councils. At present, however, the section between Bolton and Darwen has not been constructed.

Exchange of traffic with Wigan is not at present possible, because of the narrow gauge—3 ft. 6 in.—adopted by the latter. The Wigan tramways are, however, in process of conversion to standard gauge, and in a few months Wigan and the adjoining townships will be in direct communication with the 750 miles of tramway which already exist in Lancashire.



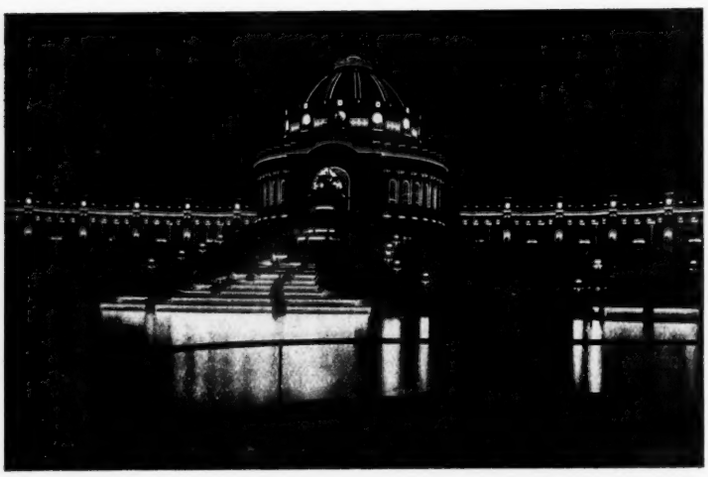
Tramcar Motor Open.

Hitherto the Company has only constructed 30 miles of route, but it carries on operations over a total of more than 50 miles, and will eventually embrace a total of 124 miles. It should not be forgotten that besides the passenger traffic, there is an immense amount of goods traffic throughout South Lancashire, a great proportion of which cannot possibly be dealt with by the railway companies, but will be easily handled by the tramways, with the minimum of transshipment and manual labour. Much of the goods traffic can conveniently be carried on by night, so as to leave the tramways free for passenger traffic in the daytime. The admirably progressive views held by Mr. Bellamy, the manager of the Liverpool Corporation Tramways, on this subject were well set forth in his presidential address to the Municipal Tramways Association, reproduced in abstract in our issue of September 30th; and we may confidently anticipate, in view of past events, that his Corporation will be similarly open-minded and willing to work for the public



150-kw. Motor-generator.

weal. The successful results which may be looked for from the adoption of up-to-date practice in this and other respects may possibly inspire other local authorities to adopt a considerate attitude towards the needs of their constituents.



Festival Hall at St. Louis, with Electrical Illuminations by Night.

In conclusion, we wish to express our thanks to the engineer-in-chief, Mr. J. R. Salter, and to Messrs. Kincaid, Waller, Manville & Dawson, for facilities to photograph the plant and for particulars relating to the undertaking. Most of the photographs were taken for us by Messrs. Entwistle, Thorpe & Co., of Manchester.

LOUISIANA PURCHASE EXPOSITION.

The purchase of the Louisiana territory from France in 1803 forms one of the most important transactions in the history of the United States. St. Louis is now celebrating, by its Exposition, the expiration of 100 years of peace and progress since that great event.

This territory of 875,000 square miles (one third of the Republic) was bought for the absurd sum of $15,000,000.

The whole Exposition is laid out in a very artistic way, and the harmonious grouping of the buildings is most charming.

The Palace of Electricity is situated north of the Festival Hall, the most imposing building of the fair, and is built in the shape of a pentagon, enclosing a symmetrical court in the centre. The illumination of this palace is very fine, and undoubtedly the best on the grounds. We give herewith a view of the Festival Hall by day, and of the electrical illuminations with which it is outlined by night; and elsewhere in this issue we commence a report of the proceedings at the International Electrical Congress recently held at St. Louis.

Festival Hall and Lake, Louisiana Purchase Exposition.

EVENING CLASS INSTRUCTION.

By E. KILBURN SCOTT, A.M.I.C.E., M.I.E.E.

It is about time someone spoke up for evening-class instruction, for of late there has been a good deal of cheap talk about its shortcomings. Much of this has been from academical cynics whose training and sphere in life makes it impossible for them to know the real facts.

The writer's view is that there is far too much thought and money being spent in trying to train men in colleges for the positions of captains of industry. What we want to do is to train plenty of what may be called the non-commissioned officers of engineering, and there will then be no lack of bright men to push themselves into the captain's position.

Personally, the writer has no use for the "fiftiquida" or the college boy with money or influence, whilst there are young men about who have combined practical training in the shops with theory learnt in the evening. If there is anything in the sandwich system, surely the sandwich taken week by week is ideal.

One very great advantage which the evening class has over the day class, is that the teachers may be men who are actually engaged in practical work, and the number of such who can impart knowledge is increasing yearly. To take an example—Who would not rather learn machine construction and drawing from the leading draughtsman of some local engineering works than from a day college lecturer? The reasons for preferring the man engaged in practical work are obvious.

Regarding the question of whether young men are strong

enough to attend evening classes after a day's work in the shops or drawing office, it is pretty certain that if an hour or so two or three evenings a week is going to knock them up, they are much better out of engineering, for it is a hard graft profession.

As a matter of fact, quite independently of what a young man may learn, evening classes keep him out of mischief. They also bring him into contact with others in the same walk of life., and this is a training in itself.

Instead, therefore, of carping at evening classes, everything should be done to increase their efficiency, and, seeing that a great deal depends on the personality of the teachers, it is of the greatest importance to attract the right kind of man. It is here that the standing of the evening class and the question of remuneration come in.

If evening class instruction is to be improved there must be direct representation of those interested in it. At present nearly all the experts who have any influence on boards controlling educational expenditure are wholly interested in day teaching, and it is to be feared, in many cases, are openly opposed to evening class instruction.

One has only to look round at the men who hold leading positions in engineering, or are really doing the work, to see that evening classes have done a good work in the past. It should be a pleasure for those who have benefited by them to help scotch the cheap sneers of the superior person.

TRAMWAY AND RAILWAY NOTES.

(*Continued from page* 618.)

Glasgow.—The extension of the tramway system from Clydebank to Dalmuir was inaugurated on Monday last.

The proposed large extensions of the Corporation tramway system came before a meeting of the T.C. on Thursday of last week, when the matter gave rise to considerable discussion. The following extensions, which were unanimously approved of in Committee, were adopted without demur:—

(1) Paisley Road Toll to Pollokshields and Govanhill; (2) Pollockshields (present terminus) to Dumbreck Road; (3) Parkhead Cross to Dalmarnock Road; (4) Garngad Road to Blochairn Road; (5) Wilton Street to North Kelvinside; (6) University Avenue to Hyndland Road (Clarence Drive); (7) Dumbarton Road to Broomhill Drive *via* Crow Road; (8) Kirklee Road, Oran Street, Bilsland Drive, Hawthorn Street, &c.; (9) Possilpark to Lambhill.

In regard to the extension to Baillieston some opposition was encountered, but the proposal was carried by a large majority. In moving the extension from Tollcross to Uddingston, Mr. Paton, the convener, held that within a short time the Corporation would have to extend its boundaries to Tollcross, and the result would be that the tramway line there as at present would not extend to the boundary. But, he said, there was a stronger argument. This was the last opportunity the Corporation would have of going to Uddingston. The Lanarkshire Tramway Co. had made an arrangement with the Lanarkshire County Council by which the tramways were to come down from Hamilton to Uddingston, and that Council was anxious that the Corporation of Glasgow should make the line to Uddingston. Under an agreement with the County Council, the Lanarkshire Co. were not to make the line to Uddingston for three years. Eighteen months of that period were past, and if the Corporation did make the line, the County Council would go to Parliament next year for power. It was apparent to him that if the Corporation made this tramway it would pay from the first. The sole object that the Corporation had was to get the leading thoroughfares for a few miles round about Glasgow into their own hands for tramway purposes. The extension was objected to on the ground that the trend of population was to the west; that in the east end there had been in recent years no extension of the city. The cost of this extension would amount to no less than £100,000, with £11,000 a year for maintenance and working, in all, and it was maintained that the earning would not defray such a working cost. The proposal was carried by a large majority. The meeting had also under consideration a number of proposed extensions which the Tramways Committee did not see their way to recommend for approval. These extensions, however, were adopted by the Corporation with the exception of that from Riddrie to Cogganfield. The following were those adopted:—Maryhill to Canniesburn Toll; Spiers Bridge to Barrhead; Springburn terminus to Balgray Hill. It may be added that the Spiers Bridge to Barrhead extension was proposed by the Tramway Committee a year ago, but was dropped on account of the keen opposition of the railway companies.

Heywood.—At a conference of the local authorities on Monday evening, it was announced that the difficulty with regard to Royton had been overcome, and that arrangements had been made to complete the purchase forthwith. The other matters in dispute between the different authorities are in a fair way for settlement.

Indian Railways.—According to an Indian newspaper, the question of the electrification of the Kalka-Simla Railway may be taken up. "With coal at Rs. 18 per ton at Kalka, the cost of steam locomotion must always remain very high, and comparatively few trains can be run, while the speed is necessarily slow owing to the heavy gradients."

Ipswich.—The accounts of the Corporation tramways department to March 31st last have just been issued. The car-mileage amounted to 182,897, and the number of passengers carried to 1,339,618. The total working costs were £6,091 and the revenue only £5,644, so that there was a deficit of £447, but the various sections have been opened for traffic during only four months. The total working expenses per car-mile amounted to 7·99d.; the total length of route now in operation is between 9 and 10 miles.

Liverpool.—Mr. Thomas Utley has returned to the attack on the management of the Liverpool tramways, and predicts a large expenditure on renewing the permanent way and cars, at an early date. Some of the points raised by Mr. Utley are that the Electricity Committee have never received proper payment for the energy which they have supplied for tramway uses; and he maintains that the repairs of the cars are entailing a serious expenditure, and instances that in the first eight months of the present year, cars which cost £550 have cost in repairs, £70 per car, equal to £105 per annum. He states that the condition of the permanent way is bad, and that through its bad condition a serious strain is being put on the cars. Also, that the practice of overcrowding, which is allowed in Liverpool, and which through a good part of the day is the normal condition, is injurious to the cars and wrong economically, owing to the heavy strain on the structure of the cars, which were not built to stand the serious overload; and to the abnormal demand for energy. Speaking of the overhead equipment, Mr. Utley says that wear and tear are telling on this, and that a huge expenditure is staring the ratepayers in the face, over replacement. Mr. Utley condemns the present top-covers to the cars as being objectionable from the standpoint of health, and dangerous in the event of the falling of a live wire. Mr. Utley concludes his indictment of the policy pursued in the administration of the Liverpool tramways by quoting the words of Sir Charles Petrie, chairman of the Tramways Committee, when opposing the adoption of a penny fare on September 14th last:—"The permanent way is in a very bad condition, and a considerable expenditure will have to be incurred at an early date on repairs."

Manchester.—The City Council, at its meeting last week, authorised the Tramways Committee to take the necessary steps for constructing tramways on certain roads in the area of the Busklow R.D.C. and the Cheadle and Gatley U.D.C. The projected lines were authorised by Parliament on the application of the Manchester Southern Tramways Co., whose powers have since been transferred to the Manchester Corporation.

Nelson.—It was reported at a meeting of the T.C. this week that a loss had been incurred in working the Barrowford section of the borough tramways of 1½d. per car-mile, and that, if it were not for the much better receipts on the other section, the loss on the Council's undertaking would be considerable. The question resolved itself into a re-arrangement of the stages, but it was decided not to make any alteration at present. It is hoped that a working arrangement may be made with Burnley for through traffic.

South Shields.—After some years of discussion, the matter of the municipalisation of the system of tramways for the borough has now been settled. At the meeting of the 29th ult. it was formally moved that the resolution adopted by the Council that the offer of the South Shields Tramway Co. be regarded as a basis for agreement, be rescinded; the grounds ostensibly being that the Committee could not see its way to recommend the acceptance of any of the tenders under consideration. On a motion, the Committee's recommendation was carried. Councillor Wylie then moved that the system be municipalised. He contended that the public control of the tramways was the better principle. This proposition was formally seconded, but was met by considerable opposition, Councillor Barlow pointing to the Newcastle trams which were not, by any means, the gold mine that was prophesied. The meeting was subsequently adjourned until the 3rd inst., when another long debate ensued, followed by a further adjournment.

A decision was come to at the adjourned meeting of the Council held on the 10th inst, when the debate was resumed. Alderman Bowman resumed the discussion, and strongly opposed the motion to municipalise. He emphasised the importance of the question from a financial point of view. The whole scheme would involve an expenditure of £153,000, and a sum of £8,800 would be required annually for interest and redemption. The present trams and 'buses carried something like 3,000,000 passengers every year, and the gross revenue was about £12,400. He admitted that the electric cars would carry more than the present horse trams; but the question was, Would the receipts be large enough to make the system pay? There was, too, the question of depreciation to face. He pointed out, too, the opposition they would have to contend with. Alderman Rennoldson also was against the motion to municipalise the system. The Council had decided that they could not accept the tenders that had been before them for constructing and working, and now he moved as an amendment that the Corporation should lay the lines and provide the electrical equipment, and that they should advertise for tenders from companies or firms for leasing the line and providing the rolling-stock. He regarded trams as a necessity. Clr. C. H. Marsh formally seconded the motion.

Alderman J. Imrie said, if they municipalised, they would get good lines, a good service and cheap fares, and a probable loss—at any rate, a problematical gain. If they took the B.E.T. Co., they would get probably poor lines, a poor service, and a certain loss. On the other hand, if they municipalised, they would still have the B.E.T. Co. applying for, and getting as certainly as possible, running powers over their lines. He thought the whole question of municipalising might be deferred until the lines were laid. The amendment was then put to the meeting, and negatived by 22 votes to 13. Alderman Imrie then moved a further amendment to the effect that the question of working or leasing should be left over until the lines were laid, but this was lost by 29 votes to 6. The motion to municipalise was then put, and carried by 21 to 15.

Spain.—The Sociedad Tranvia del Este de Madrid has applied for a concession for several projected new lines of electric tramways in Madrid.

Stalybridge.—An accident happened on Tuesday (October 11th), on the recently-opened line of the Stalybridge, Hyde, Dukinfield, and Mossley Electricity Board. About mid-day a car, in descending a steep hill at Millbrook, Stalybridge, got beyond the control of the driver, and at the bottom of the decline jumped the metals, and ran violently into the wall of a cottage. The wall was knocked in, and the roof partially collapsed. A child, aged four years, was killed, and seven other passengers were injured, some seriously. The driver, Ernest Knell, stuck to his handles to the last, and when taken out of the *débris*, badly cut about the head, declined assistance until the injured passengers had been attended to. The vehicle was a complete wreck.

TELEGRAPH AND TELEPHONE NOTES.

Alaska Telegrams.—The *Daily News*, October 8th, states that a telegram from Seattle says telegraphic communication has now been established between that place and all parts of Alaska, the cable between Valdiz and Sitka having been completed on the 7th inst. There are now 46 telegraph stations in Alaska.

Continental Cables.—The *Journal Télégraphique*, at the request of Messrs. Felten & Guilleaume, of Mülheim, on the Rhine, and with the consent of the German Government, has published a review of the operations of this firm during the 50 years of its existence. The firm manufactured a cable in 1853, claimed to be the first manufactured on the Continent.

The Actien-Gesellschaft Norddeutsche Seekabelwerke have constructed the German Atlantic cable, and are now manufacturing that for the German-Dutch Telegraph Co.

Foreign Governments now appear to be beginning to appreciate the importance of possessing their own uncontrolled telegraph routes.

German Cables.—The *Zeitschrift für Post und Telegraphie* states that the Sultan has given his consent to the landing of a cable to be laid by German enterprise between Constantza and Constantinople. From thence a telegraph line will be erected along the new German railway to Bagdad, which will thus extend the German telegraph line from Berlin to Constantinople *vid* Scutari, Angora, Diarbekir, Moussoul, Bagdad, and thence by Bassora and Fao to the Persian Gulf. This line is to be known as the "B.B.B." line, because it connects, among others, the following important towns whose names commence with "B," viz.:—Berlin, Breslau, Burdujeni, Bucarest, Bysance, Bagdad and Bassora.

A *Standard* telegram says the contract between the Sublime Porte and the German cable company for the laying of a cable to Constantinople, &c., was signed on 9th inst.

According to the *Allgemeine Zeitung*, on July 19th last, at Cologne, a company was formed entitled the "German-Dutch Telegraph Co." (Compagnie Germano-Néerlandaise des Télégraphes). The company will lay the cables from Menado to Guam and Guam to Shanghai. These cables will be joined to the Dutch system, to the American Pacific, and the Shanghai-Tsingtau-Chefoo cables belonging to the German Empire, and to the cables of the Great Northern and Eastern Telegraph Companies. The management is in the hands of one German representative (Mr. Pfitzner, Chief Inspector of the Postal Department, which office he resigned to take up his new duties as from 1st inst.), and one Dutch representative, Captain Le Roy.

Italian Telephone Cables.—The *Journal Télégraphique* states that Messrs. Pirelli & Co., of Milan, are constructing a telephone cable to be laid between Italy and Sicily. This is the first cable of the kind manufactured in Italy, and its length will be 9 kilometres.

National Telephone Co. v. Jenkins.—In the Lord Mayor's Court, before the Recorder (Sir Forrest Fulton, K.C.) and a jury, on Tuesday, plaintiffs claimed against defendant, of 140, Leadenhall Street, E.C., to recover £18 5s., a year's subscription for the use of a telephone wire and a set of instruments. From the *Times* it appears that defendant had refused to pay a year's subscription due in advance on October 15th last year, on the ground that between September 28th and December 9th, 1903, at which latter date the line was disconnected, the company did not maintain the line and instruments in good working order, and that the consideration had totally failed. Plaintiffs admitted that a few complaints had been made, but stated that whatever faults were discovered were at once remedied. One of the clauses in the agreement between the parties provided that in the event of the line not being in good working order the company should repair and restore the same at its own expense with all possible dispatch, but it was not to be held responsible or liable to the subscriber for any delay, provided every reasonable endeavour was made to restore the communication as speedily as possible. It was contended that this had been done. Replying to the Recorder, Mr. Gaine, for the plaintiffs, said it was arguable whether, supposing there had been a failure to supply communication before October 15th and up to November 30th, it would be sufficient to justify the defendant's refusal to pay the subscription. He might have a ground of action against the company. The Recorder said that was not so, because the company carefully protected itself against actions for damages for failure to supply the communication. Mr. Gaine admitted that there was an obligation on the company to give a reasonably sufficient service, but his contention was that the line and instruments were not out of order during the whole of the time mentioned. A number of witnesses were called, and in the result the jury found that the line was not fit for use. Judgement was entered for the defendant on the claim, and also for the defendant on a counter-claim which he had raised for the agreement to be delivered up and cancelled.

Portsmouth Telephones.—A strong opposition will be offered to the proposal of the Corporation to borrow £20,000 for further developing the telephone system. At Tuesday's meeting of the T.C., the Telephone Committee reported the receipt of a letter from the Secretary of the General Post Office, enclosing draft of a proposed deed for the extension of the Corporation telephone area, so as to include Rowland's Castle, situate about nine miles from Portsmouth.

Telegraph Cable Exports.—No improvement is discernible in the export trade of this country in telegraph cables and apparatus connected therewith. The shipments last month reached a total of only £33,302 as compared with £50,377 in the preceding month and £44,097 in September, 1903. The extent of the decline that has taken place this year in this branch of trade is indicated by the fact that the aggregate exports during the nine months ending with September last only attained a value of £627,522, which contrasts with £1,572,563 in the corresponding period of last year and £2,226,732 in the first nine months of 1902.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Trinidad-Demerara (No. 2)	Oct. 10, 1904	
Dominica-Martinique	May 7, 1903	
St. Lucia-Martinique	May 7, 1903	
Cayenne-Pinheiro	Aug. 13, 1903	
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1903	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostock-Nagasaki / Port Arthur-Chefu	Feb. 9, 1904	
	Mar. 9, 1304	
Paramaribo-Cayenne	July 13, 1904	
Cape Haitien-Mole St. Nicholas	Aug. 20, 1904	
Bundaberg-Gomen (New Caledonia)	Aug. 30, 1904	
Braso-Bonny	Oct. 10, 1904	
Cape Town-Swakopmund	Oct. 10, 1904	
Swakopmund-Mossamedes (under repair)	Oct. 10, 1904	
Landlines.		
Cartagena-Baranquilla	Dec. 8, 1900	
Puerto Bairros	July 28, 1902	
Seoul-Masampo	Feb. 18, 1904	
Seoul-Gensan	Feb. 18, 1904	
Anju-Ping-Yang	Feb. 25, 1904	
Ninguta-Vladivostock	March 2, 1904	
Caimanera-Santiago	June 15, 1904	
Kertch-Soutehoum	Sept. 27, 1904	
Fao route	Oct. 7, 1904	Oct. 9

Wireless Telegraphy.—A Reuter telegram from Paris states that a radiographic station has been opened at Ushant for the purpose of communicating with ships at sea. The station will transmit messages from the mainland, and will receive messages for addresses in France, Algeria, Tunis, Monaco, and Andorra.

Execution by Electricity.—According to the New York correspondent of the *Lancet*, the frequent failure of electrocution is causing considerable comment in medical circles. It has been found that different convicts require a different number of volts to produce the same results. One convict received 1,750 volts and recovered, and then he received 1,900 volts without fatal effect. Recently a condemned man received a shock of 1,700 volts, which was continued for 30 seconds without causing death. This number had to be repeated four times before he was declared to be dead. The explanation made in the latter case was that the criminal was very thin and his body was a poor conductor, and also that his hair was thick and oily. It has been suggested by physicians who have witnessed these executions that very many criminals who have been electrocuted might be restored if proper efforts were made immediately. The sure death in many cases is believed to be due to the necropsy, which is at once made, and not to the electrical shock.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aston Manor.—October 14th. Engine room, electrical and general stores for the Town Council. See "Official Notices" October 7th.

Antwerp.—October 15th. The Municipality of Ghent invites tenders for the construction of 10 electric cranes at that port in accordance with the specification, a copy of which may be seen on application at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, E.C.

Barrow-in-Furness.—October 18th. Arc lamps, columns, bases, switches, &c. See "Official Notices" September 30th.

Carlisle.—November 1st. Two Lancashire boilers, two 50-kw. and one 30-kw. steam dynamo, 5-ton travelling crane, economiser, cables and boxes, wiring of buildings, switchboards, motors, fans, &c., for the Cumberland and Westmoreland Lunatic Asylum. See "Official Notices" September 30th.

Dublin.—October 24th. Cast-iron troughing and covers for the Electricity Supply Department. City engineer, Mr. Spencer Harty, City Hall. Specifications, &c., 21s., refundable.

Fulham.—October 19th. A 3,000-volt main generator switchboard for the Electricity Department. See "Official Notices" October 7th.

Great Western Railway.—October 17th. Tenders for a year's stores. For list of electrical sections see "Official Notices" September 30th.

Hackney.—The Electricity Committee of the B.C. will shortly invite tenders from a few firms for 1,000 demand indicators (estimated cost 30s. each), and for arc lamps for lighting four roads. Mains extensions estimated to cost £141 5s. are to be carried out.

Ipswich.—Continuous-current meters for the Electricity Department for 12 months. See "Official Notices" October 7th.

Leicester.—October 18th. Installation of internal telephonic systems for the new workhouse infirmary for the Guardians. Particulars from Giles, Gough & Trollope, architects, 28, Craven Street, Charing Cross, W.C. (21s.)

London.—October 24th. L.C.C. stores for a year (electric fittings, cables, tubing, &c., are among the specified items). Particulars from County Hall, Spring Gardens, S.W. (send stamped foolscap envelope).

Middleton.—October 25th. Dust destructor, Lancashire boiler, superheater, piping, &c., for the Electricity Department. Particulars from Town Clerk (one guinea).

Newport (Mon.).—Tools for the power station and car-sheds for the Council (estimated cost £190).

Northampton.—October 24th. Steam coal for the Corporation tramways. See "Official Notices" to-day.

Preston.—November 9th. Motors and tramway boosters for the Tramways Committee. See "Official Notices" to-day.

Shanghai.—March 31st, 1905. Construction and working of 24 miles of electric tramways on the trolley system, double or single. Conditions, plans, &c., on application to Messrs. Pook & Co., agents for the municipality of Shanghai, 63, Leadenhall Street, E.C.

Sunderland.—October 18th. Two 300-kw. three-phase 5,000-volt generators to couple direct to existing Belliss engines; two 300-kw. synchronous motors, 5,000 volts, to couple to existing Silvertown multipolar dynamos. See "Official Notices" Oct. 7th.

Swansea.—November 12th. Removal, alteration and re-erection of a 450-i.h.p. triple-expansion engine and a 225-kw. continuous current dynamo. Also an 8-ton travelling hand-crane, for the Electricity Department. See "Official Notices" to-day.

Tamworth.—Offers for the construction and maintenance of electric lighting works are invited by the Corporation. See "Official Notices" October 7th.

Tottenham.—October 21st. The U.D.C. is open to enter into negotiations with a company to exercise the powers under its E.L. prov. order. See "Official Notices" October 7th.

CLOSED.

Battersea.—The B.C. has placed an order with the British Thomson-Houston Co., Ltd., for 70 prepayment electricity meters, for workmen's dwellings, at £5 each. In consideration of this, the company are to replace, free of charge, the whole of the meters previously supplied, with meters of the latest improved type.

Brighton.—The T.C. has accepted the tenders of the British Westinghouse Co. for constructing a switchboard gallery at the Southwick station, at £820, and for constructing the basement floor, at £5,285.

Colchester.—The Tramways Committee of the T.C. has accepted the tender of Messrs. J. G. White & Co., Ltd., for permanent way material, at £1,132 13s. 3d., and that of Messrs. Boulton & Paul, Ltd., of Norwich, for covered ways over the approaches to the North Station, at £592 9s. 6d.

East Ham.—The U.D.C. has accepted the following tenders in connection with the new tramways:—Messrs. Dick, Kerr and Co., Ltd., tram rails, £6 10s. per ton; fish plates, £7 15s.; tie-bars, £11; bolts and nuts, £14 10s.; 29 30-ft. lengths and six 35-ft. lengths of special heavy rails for curves, £7; ditto, covering in the top of six cars, £85 per car.

London.—The following tenders have been received by the London County Council for the supply of transforming plant for the temporary provision of power at the Greenwich generating station in connection with the erection of machinery, the current to be supplied by the South Metropolitan Electric Light Co. at rates varying from 4·5d. to 1·25d. per unit:—

	Time for delivery.	
Electric Construction Co., Ltd. (recommended) ..	14 weeks ..	.. £860
Johnson & Phillips, London	16 ,, ..	.. 860
British Electric Plant Co., Ltd.	8 ,, ..	.. 940
Lancashire Dynamo & Motor Co., Ltd.	13 ,, ..	.. 1,004
British Westinghouse Co., Ltd.	10 ,, ..	.. 1,083

The L.C.C. Fire Brigade Committee has received the undernoted tenders for the wiring and fittings for the Eltham sub-station:—

A. H. Marshall & Co. (accepted)	£139 10
National Electric Construction Co.	144 0
Durell & Co.	148 0
Oliver, Clark & Co.	155 0
F. J. Coleby & Co.	155 0
G. Weston & Sons	155 10
Leo Sunderland & Co.	160 0
Rashleigh, Phipps & Co.	161 0
W. H. Johnson	181 15
Alliance Electrical Co.	184 13

Newcastle Industrial Exhibition.—The Union Electric Co., Ltd., have received the order for the supply of all the arc lamps required for the illumination of the above exhibition; the Excello Intense Flame Arc Lamp has been accepted.

Newport (Mon.).—The T.C. has accepted the following tenders:—

Switchboard: Johnson & Phillips.
100 arc lamp brackets: Thomas & Price, 7s. 1d. each.
100 arc lamp switches: General Electric Co., 8s. each.
High tension cable: Siemens Bros. & Co.
Instruments: Kelvin & James White.

Portsmouth.—The T.C. adopted a recommendation from the Committee that the tender of the British Insulated and Helsby Cables, Ltd., for 120 km. of cables (£252 10s.) be accepted. The other tender, from W. T. Henley's Telegraph Works Co., Ltd., was for £313 5s. 3d.

Salford.—The T.C. has accepted the tender of Messrs. Goddard, Massey & Warner, of Nottingham, for a feed pump for the Lancashire boiler at Wilburn Street depôt at £20, and that of Messrs. F. Leroy & Co. for covering the boilers and steam pipes at the Carey Street and Wilburn Street depôts, with non-conducting composition at 5d. per super square foot.

Sheerness Dockyard.—The Lancashire Dynamo and Motor Co., Ltd., have secured the order from the Admiralty for the whole of the electrical equipment for Sheerness Dockyard, in accordance with the specification of Messrs. Preece & Cardew.

West Ham.—The Corporation accepted on Tuesday the following contracts in connection with the electrification of the tramways in High Street, Leytonstone Road and Romford Road:—

Messrs. P. & W. McLellan, Ltd., for about 870 tons of British steel rails and fish plates.

Messrs. Edgar Allen & Co., Ltd. (Askhams, Ltd.), for the whole of the points, crossings, and special work at junctions.

Messrs. W. Griffiths & Co., Ltd., for 4,000 to 5,000 tons Guernsey granite setts.

FORTHCOMING EVENTS.

Friday, October 14th.—First Electro-Harmonic Smoking Concert of the Season, King's Hall, Holborn Restaurant, at 8.

NOTES.

Next Week's "Electrical Review."—The issue of the Electrical Review which makes its appearance on Friday, October 21st, will be a special one. It will describe a great variety of new electric light fittings, heating apparatus, and other devices which have lately been brought out in readiness for the current season. The issue will be printed largely on art paper, and will be profusely illustrated.

The Electro-Harmonic Concert To-Night.—We would remind our readers that the opening Smoking Concert of the season is to be held in the King's Hall, Holborn Restaurant, to-night. Mr. John S. Raworth will take the chair at 8 p.m. A large gathering is expected.

South African Notes (from our Durban correspondent).—*Pietermaritzburg.*—The "tramway muddle," as the local press designates it, is still the subject of much criticism. The latest development is an objection raised by the Government engineer to the raised "Vignoles" track, of which there are some three miles laid. Under the terms of the Pietermaritzburg Tramway Law, which states that "the uppermost surface of the rails shall be on a level with the surface of the roads or streets" (which, however, only applies to roads or streets actually used for traffic), the Government have insisted on the railway street track, of which there is about 600 yds. of "Vignoles" rails, being at once relaid with "girder" track, in the centre of the street, as in other portions of the town. This is being proceeded with at once, and as a consequence the side bracket poles will be replaced with span wire construction. It will be remembered that on the appointment of the tramway manager (Mr. P. Finlayson), a somewhat lengthy report was submitted by him, pointing out amongst other matters, his objection to the adoption of the "Vignoles" rail. Another objection raised by the Government is against the embankment and bridge on the Fox Hill Spruit of the Scottsville route, which has to be lowered 4 ft., and 300 yds. of "Vignoles" track relaid with rails of the "girder" section, and the existing roadway raised to an equal level with the track. The borough engineer estimates the expenditure at £3,398, the actual loss representing £757; the rails, &c., removed being counted as an asset, available for further extensions, or they may be realised in cash. These alterations will still further delay the opening of the tramways, but it is hoped to have a portion running in about a month's time.

East London.—The contractors, Messrs. Strong & Moore, of Durban, are now starting the extensions of the track for the tramways of the above town, which will add another two miles to the system.

Vryheid (Natal).—The Vryheid Local Board has granted the concession for the electric lighting of the town to Mr. E. H. Godfery, of Harrismith (O.R.C.), who hopes to have the lighting in full operation by the end of the year.

Durban.—The borough electrical engineer, Mr. J. Roberts, has returned from his six months' leave, and in an interview with a representative of the local press, he said that he was pleased to consider that Durban was well abreast of "home" practice in electrical work. The question of extensions of the power station plant is likely to receive early attention, a system of coal conveyors being introduced, also additional traction plant, instead of batteries, being advisable.

Ladysmith (Natal).—The Electric Light Committee of the Town Council is recommending that the charges for electric light be reduced from 1s. to 9d. per unit, and the discounts now in force abolished.

Another correspondent says:—

Kimberley.—A local contemporary chronicles the fact that a start has been made with the electric tramway to Alexandersfontein, "the contractors having commenced work from the railway line beyond the racecourse, working towards Kimberley."

King William's Town.—At a special meeting of the T.C., called to consider the finances of the town, it was incidentally stated that the Council "would also have to consider in the course of a few days the question of taking over the electric light installation, and that would necessitate an additional loan of, approximately, £25,000."

Our South African Electricity Works Table.—Regarding the particulars of Aliwal North given in our recent table of South African stations in the section headed "Lighting Schemes in Progress," the Industrial Engineering Co., of Manchester, write to say that the entry should not have been included in this section, as the scheme is completed. They are shipping this week two 50-kw. generators, two 5-kw. boosters, one balancer, two milking sets, &c., for this town. The machines were made under the specification of Messrs. Burstall & Monkhouse, who are the consulting engineers.

Electricity Works and Tramways Tables Addenda:

Woking, Horsell, and (part) Chertsey:—Maximum load recorded, 287 kw.; private lighting, 25,013 8-c.p. lamps (December 31st, 1903); total units sold, 271,807; average price obtained, 6·57d.; works and dist. costs, 2·63d.; total costs, 3·57d.

Newcastle-upon-Tyne Tramways:—Delete A. E. Le Rossignol (resigned). 24 miles of route; 117 d.d., 68 s.d. cars; hand, rheostatic, mechanical, and electrical track brakes; capital outlaid on tramways and rolling stock, £856,091; on power station, £198,402; annual electric car-mileage, 4,100,000; passengers carried, 40 millions; working cost per car-mile, 7·19d.; ratio expenses: receipts, 65·5 per cent.

Mersey Railway Society.—Before the Mersey Railway Engineering Society at its opening meeting for the first winter session on Oct. 3rd, a paper was read by Mr. E. Christian on "Electric Railway Rolling Stock," with admirable lantern illustrations. Mr. J. Shaw, resident engineer of the railway, presided.

Electricity the Scapegoat.—A fortnight ago the Church of St. Chrysostom, Victoria Park, Manchester, was destroyed by fire, the disaster being attributed to a fusion of the wires forming part of the electrical installation. The alleged cause is repudiated by the Electricity Committee of the Manchester Corporation. At the last meeting of the City Council, Mr. Hesketh, deputy-chairman of the Committee, said that an exhaustive inquiry which had been made into the matter, proved that there was no truth in the suggestion of defective wiring. Every electric installation was carefully inspected by competent men before it was used. St. Chrysostom's was examined a day or two before the fire, and found to be in perfect condition. The current was switched off at 7 p.m., and the fire broke out at 11.20. In these circumstances it was impossible to attribute the fire to any defect in the installation.

Mr. S. L. Pearce, the Manchester City electrical engineer, prepared a report to his committee, plainly showing that the fire was not electrically caused. It was stated therein that when the installation was tested, a large fire in the vestry was burning up all the rubbish that had accumulated during the alterations, and further, that a gas ring was used at the back of the organ for hot water purposes.

Mr. E. P. Steinthal, hon. secretary of the Manchester Branch of the Electrical Contractors' Association, after consultation with the chairman of the Northern Section (Mr. J. McDermott), called an Emergency Committee to report on the matter of the fire, the contractor for the work being a member of the Association. The report of this Committee was published in the Manchester papers, together with Mr. Pearce's report, and it takes the blame off the shoulders of electricity, and lays the responsibility to the account of a rival illuminant, which we are confident causes a good many more fires than it generally gets credit for. There was distinct evidence of an escape of gas in the organ chamber, and herein is suggested a possible source of danger, though, charitably enough, the Emergency Committee admits that "up to the present there is not sufficient evidence to show the actual source of ignition."

Those who were responsible for the inquiry and report into the cause of this fire are to be congratulated upon the promptitude with which they took the matter up. Such energetic action, if repeated in other towns when such occasions arise, might do a great deal of good by exposing the wild statements made by the imaginative reporters of the newspaper press, as to the culpability of electrical contractors' work for fires for which it is in no measure responsible.

London County Council.—On the resumption of business on Oct. 4th, the Council referred to Committee a number of tenders received for the supply of condenser water pipes, electric car traversers, and pumping plant for the Greenwich power station.

The Highways Committee reported that a decision had not yet been arrived at in regard to the system of electric traction to be introduced on the lines acquired from the South London Tramways Co. in 1902, but it would in any case be necessary to provide substations. Steps had already been taken to secure certain sites, and an expenditure of £1,085 was sanctioned for obtaining a further site in Queen's Road, Battersea.

Approval was given to plans submitted by the Woolwich Borough Council for making an addition to the engine room, and by the Marylebone Council for the construction of two cooling towers at the generating station in Richmond Street.

The Council has decided that it was not possible to extend the principle of workmen's fares from 8 a.m. to 9 a.m., the contention being that by so doing it would incur a monetary loss. During the Council's 10 weeks' recess 25 accidents have occurred to the system, costing £2,000 in compensation and law costs. The Highways Committee, it is stated, has resolved to experiment with motor-trams on the existing horse tramway routes pending the conversion to electric traction.

At the meeting on Tuesday this week, the Council resolved to lend £23,960 to the Stepney Borough Council for electric lighting works and the provision of meters.

The Highways Committee reminded the Council of the temporary arrangements made with the City of London Co. for the supply of power for working certain short lengths of tramway in Southwark and Bermondsey. The supply of power, however, from the temporary station at Bankside, as well as from those at Loughborough Junction and Deptford, was strictly limited, and the maximum number of cars was now being operated. The heaviest load on the generating plant occurred in the early part of the evening, when a further supply of power was required for the lighting of the cars, and more power was needed to fully meet the requirements of the present time. The Committee, therefore, proposed to obtain an additional motor-generator for the Bankside Station and one for the Elephant and Castle, the plant to be supplied by Messrs. Dick, Kerr & Co., at a cost not exceeding £3,500.

The Council approved an expenditure of £500 for the provision of additional switch pillars, in order to divide into a larger number of sections, the distributing service in the neighbourhood of the Elephant and Castle and St. George's Circus. The object is to minimise, as far as possible, the extent of the stoppages which now occur in the locality.

The Local Government Committee reported having had under consideration the question of the re-assessment of the tramways in Lambeth in consequence of the reconstruction of the lines. The Lambeth assessment authorities placed the lines (exclusive of the Brixton portion which was out of use) in a provisional list at

£13,500 gross and £9,000 rateable, which list was confirmed on May 25th, 1904. The figures were subsequently inserted in a supplemental list, and after the completion of the reconstruction of the Brixton line, the assessment was increased in a provisional list, dated July 23rd, to £18,000 gross and £12,000 rateable. Notices of objection to these assessments were served; and at the hearing of the objection on September 26th, the Council was represented by counsel. It was pointed out to the Assessment Committee that, although the tramways in Lambeth might might now be more remunerative than at the time of the last quinquennial revaluation in 1900, yet they had during reconstruction yielded no surplus revenue at all, and that the maintenance of the quinquennial figures during the entire period would probably more nearly approximate to an equitable assessment. Eventually the Assessment Committee agreed that the quinquennial assessment of 1900 should remain unaltered, and reduced the assessment to £11,092 gross and £7,402 rateable.

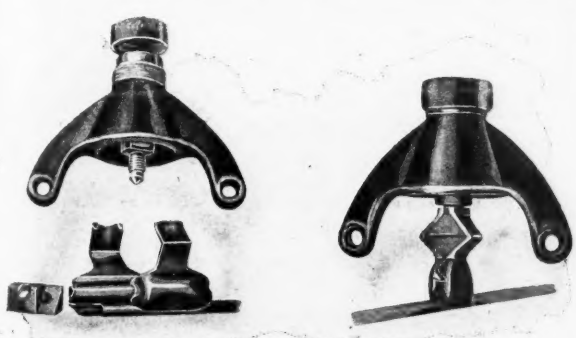
The Birmingham Electric Club.—The meeting to consider the proposed formation of an electric club for the Birmingham district, as mentioned in our last issue, was held on Saturday last, Mr. J. W. Innis presiding. It was resolved to appoint a committee of seven to consider the whole matter and report.

Railway Men and Electrification.—In view of the fourth fatality on the new Southport-Liverpool Electric Railway, the Amalgamated Society of Railway Servants at Bradford, on the 6th inst., adopted a resolution: "Viewing with alarm the multiplication of the dangers of railway work consequent upon the introduction of electric traction, and calling upon the Board of Trade to frame such regulations as would most effectively protect both the public and the men against the dangers of the 'live' rails."

Gas Disaster.—On Monday morning there was a disastrous explosion at the Saltley gasworks of the Birmingham Corporation. Three men were killed, and a number were seriously injured, while great damage (estimated at £20,000) was also done to the buildings and plant.

Fatality.—On 7th inst. the coroner's jury at Lancaster met for the third time in the course of their inquiry into the death of Lucy Cook, the woman who jumped from the runaway electric car, and was killed. The car began to run downwards on the Bowerham route, and the driver could not stop it. His difficulty was increased by the breaking of the trolley pole. He used both the hand and the magnetic brakes. Mrs. Cook got out at the conductor's end of the car, and was thrown under the lifeguard and killed. The driver said the track was slippery, and Mr. Tester, the electrical engineer, said the brakes were in perfect order. A juryman expressed the opinion that the plough guard would have been a good one, but Mr. Tester said the Board of Trade would not sanction it, and the Liverpool Corporation used it at their own risk. The Coroner remarked that if Mrs. Cook had kept her seat she would not have been killed, and a verdict of "Accidental death" was returned.

Redford's Trolley Wire Holder.—We show in the accompanying figure this patent trolley wire holder for electric tramways, which is being introduced by the Spherical Metallic Packing and Engineering Co., of Manchester. The objects of the invention are to enable the holder to firmly support the trolley wire without the aid of solder, and to ensure that the trolley wheel need not leave contact with the substance of the trolley wire at the points of support, thus avoiding sparking. The arrangement consists of a pair of bronze plates articulated between their upper and lower edges, which are respectively shaped to form pairs of jaws. The lower jaws are shaped to seize and hold more than a



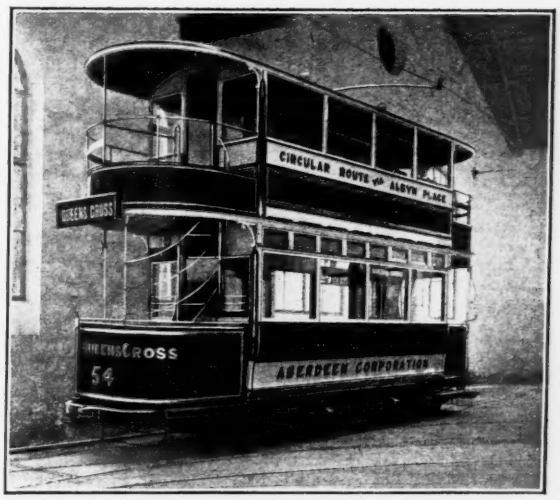
Redford's Trolley Wire Holder.

semi-circumference of the trolley wire. The upper jaws are fitted with means for suspending the holder, and, at the same time, for holding the jaws firmly apart, so that they cannot approach while in use. It is claimed that it follows from the intermediate articulation or jointing together of the plates, that while the upper pair of jaws are firmly held or forced apart, the lower pair will be firmly held upon the trolley wire. The holder is suspended by means of the usual insulated stud, and it is said to be entirely automatic in its grip. The greater the weight of wire to be suspended, or the greater the upward thrust of the trolley wheel, the greater the grip.

Horses Killed at Liverpool.—We are informed that an accident occurred near the Dingle, Liverpool, on the 8th inst. One of the overhead trolley wires had been loosened by a gale, and a two-horse repair wagon was summoned. The platform was raised, and the mechanics were getting to work when the loosened wire fell round the two horses. Both animals were immediately electrocuted.

American Society of Civil Engineers.—The thirty-sixth annual convention of this society was held on 3rd inst. at the St. Louis Exposition.

Top-Cover Cars at Aberdeen.—The accompanying photograph shows the type of top-deck tramcar cover which has been adopted by the Aberdeen Corporation. Some little time ago a deputation came South to visit various Midland cities to investigate the matter, and finally decided to adopt the type of cover used



Top-Cover Cars at Aberdeen.

by the Leeds Corporation as being the most suitable to Aberdeen conditions. Some alterations were made on the Leeds type, which were considered an advantage, but Aberdeen is primarily indebted to Leeds for the design. The Corporation has just placed an order for 20 of these covers with a local firm at a price of £125 each.

Regenerative Control in Sydney.—Before a general meeting of the Electrical Association, held at Sydney toward the end of August, a paper on "The Regenerative System of Electrical Tramcar Control" was read by Mr. Oswald Haes.

Appointments Vacant.—Second class engineers, and second class technical officer, for the G.P.O. engineer-in-chief's department; marine engineer for Carlisle electricity department (35s.); junior engineer for West Ham (42s.); assistant to installation foreman canvasser under Woolwich electricity department (42s.); canvassing engineer for the Wolverhampton electric light and power undertaking; tramway depôt foreman (45s) for Burton-upon-Trent.

Ferranti, Ltd.—In the Vacation Court on Wednesday, before Mr. Justice Warrington, Mr. Henderson appeared in support of a petition asking the sanction of the Court to a scheme of reconstruction. Mr. Jersel, who appeared for certain opposing contributories, asked that the petition might stand over, as he thought it possible some arrangement might be arrived at. It was stated that a petition for the compulsory winding-up of the company was down for hearing on the 25th inst., and his Lordship thereupon directed that the present application should come on with that petition.

Car-Top Covers at Burton-upon-Trent. — Last autumn a Burton-upon-Trent sub-committee, in conjunction with Mr. P. J. Pringle, the borough electrical engineer and tramway manager, inspected several types of covers, but although Mr. Pringle then advised them that they would be of value during last winter, it was decided to postpone the matter until the summer to find out from other towns whether there was any disadvantage from their use during the summer months. This was found not to be so in practically all cases, and an order has been given to Messrs. Milnes, Voss & Co. for three car-top covers with Magrini sides and canopy roofs extending the whole length of the cars, at £82 each. These will be in operation shortly, and if the experience of them is satisfactory further extensions will be made for the coming winter.

Accident.—On Wednesday morning, October 12th (says our Southport correspondent), a transformer broke down at the electric power station, Formby. The result was a cessation for three-quarters of an hour of the electric supply and the electric trains between Liverpool and Southport were held up for that time. The attendant on the rotary and transformer was badly burnt, his scalp being singed bare.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*]

Central Station Engineers.—Mr. Bernard Hudson, formerly of the Sheffield Corporation Electric Supply Department, and late engineer-in-charge at the Eccles Corporation electricity works, has obtained an appointment with the South Lancashire Electric Traction and Power Co., Atherton.

The Sydney, N.S.W., City Council E.L. Committee has appointed Mr. Thomas Rooke to the position of city electrical engineer for one year, at a salary of £900 per annum, to commence as from the 1st inst.

The members of the Borough of Croydon Electricity Works Lawn Tennis Club were entertained to dinner at the Greyhound Hotel on October 5th by the President, Mr. Alex. C. Cramb, borough electrical engineer, and a most enjoyable evening was spent. An interesting programme of vocal and instrumental music was provided by the members.

The Southport Electricity Committee has appointed Mr. P. E. Hale, of Blackburn, as engineer-in-charge.

Wallasey U.D.C. has adopted the recommendation of the Commi tee, that the engineer, Mr. Crowther, shall receive £280 6s. paid by Malvern U.D.C. for services rendered in connection with the E.L. scheme. An amendment that only £80 should be paid to Mr. Crowther, was negatived by 6 votes to 12.

Tramway Officials.—Mr. Clifford Womersley, chief inspector of the Huddersfield Corporation Tramways, has been appointed, out of 58 applicants, to the post of tramways traffic superintendent at Kilmarnock.

General.—Messrs. Browett, Lindley & Co., Ltd., of Patricroft, announce that the services of Mr. Fred. C. Gibbons, M.I.E.E. (who was formerly one of their joint managing directors, but who severed his connection 12 months ago to take up the position of representative in England for Messrs. James Howden and Co.), have again been secured by them under agreement for a term of years, and he now occupies the position of sole managing director of the company. The company will continue to devote itself to the production of vertical steam engines for driving electric generators.

As a tribute to the work he has done in connection with the Lancaster Corporation Electricity Works, the Lancaster Town Council has elected Mr. Councillor James Heald to the Mayoralty of the borough for the ensuing year. For the last five years he has filled the chairmanship of the Electricity Committee.

The King has granted the office of Professor of Physics in the University of Oxford, to Wm. Osler, F.R.S., D.Sc., in place of Sir J. S. Burdon Sanderson, Bart, resigned.

Mr. T. Waldemar Goulding has been appointed general superintendent of the Western Union Cable Service, vice Mr. D. Le Rougetel. Mr. Goulding will have jurisdiction over the service in Great Britain and the Continent, with headquarters in London.

Some days ago Mr. J. Parr, who for the past seven years has been works manager, and six years in another capacity at Messrs. Muirhead & Co.'s works at Elmer's End, was presented with a marble and bronze timepiece by the staff on the occasion of his retirement from the firm. The principals of the firm presented to Mr. and Mrs. Parr a gold watch apiece.

Obituary.—Mr. John Hollingshead.—In connection with the recent death of Mr. John Hollingshead, it is recorded that in 1878, when at the Gaiety Theatre, he was responsible for the first use of the electric light in a London Theatre. Negotiations with the inventor of the Jablochkoff light were not successful, or that form of illuminant would have been employed. When these negotiations came to naught he, by the aid of a newspaper proprietor, had a 20-H.P. plant put down to work a Lontin light installation, and, as a correspondent of the *Pall Mall Gazette* says, on August 2nd, 1878, the Gaiety electric lighting was an accomplished fact, Mr. Hollingshead himself describing it as "artificial daylight with a dash of moonlight in it."

Mr. George Benham Stacey.—It is with great regret that we record the death, which occurred on October 5th at Bath, of Mr. George Benham Stacey. Mr. Stacey was born in 1839, and it appears that in 1851 he entered the service of the Electric Telegraph Co. Two years later, says the *Times*, he was transferred to The Hague on the laying of the first cable to Holland, and was afterwards sent to the Prussian Government Telegraph office at Berlin, whence he was transferred in 1856 to the foreign gallery, London. From 1857 to 1859 he was in the Egyptian Transit Administration, and in 1860 he joined Messrs. Glass & Elliott's cable works at Greenwich (afterwards the Telegraph Construction and Maintenance Co.). On the laying of the first Malta—Alexandria cable Mr. Stacey was appointed to Benghazi, and became superintendent in 1863. After service in Malta he became, in 1868, superintendent of the Anglo-Mediterranean Telegraph Co.'s Susa—Modica landline through Italy, and agent to the Italian Government. Then for 28 years, until 1897, he was superintendent and afterwards manager, at Bombay of the British India Submarine Telegraph Co. (afterwards the Eastern Telegraph Co.). He was for a short time superintendent at Cape Town during the Boer war and the consequent censorship, and was also at Tangier. Mr. Stacey, who retired in 1901, was an able representative of cable enterprise, and was much respected in the service. He was of the self-contained type, of great ability, and equal to any emergency. We understand that there was no history at any station of which he was in charge, because everything went so smoothly that there was rarely anything except routine matters to report. His death severs one of the few remaining links with pioneer submarine telegraphy, among the survivors being Lord Kelvin, Sir Samuel Canning, and Mr. H. A. C. Saunders.

The *Jewish World* records the death of Herr Moses Burstyn, chief of the Electrical Engineers of the Austrian Navy, at the age of 63. He entered the Navy in 1870, and in 1903 was raised to the highest rank in his branch. He was decorated with the Order of Francis Joseph for discoveries in utilising electricity in Naval matters and was accorded the rank of Colonel.

NEW COMPANIES REGISTERED.

City of Buenos Ayres Tramways Co. (1904), Ltd. (82,214).—This company was registered on October 6th, with a capital of £1,240,000 in £5 shares, to acquire certain of the assets of the City of Buenos Ayres Tramways Co., Ltd. (now in voluntary liquidation), to adopt an agreement with the said old company, to receive payment from the Anglo-Argentine Co., referred to in the said agreement, of the annual sums therein referred to, which the last-mentioned company has agreed to pay during a period of 80 years, to hold such sums on trust as set forth in the said agreement, to farm or let out for farming, building, or other purposes, and generally to deal with and turn to account the lands of the company, to acquire or construct, maintain, work, and control any tramways, railways, roads, ways, canals, telegraphs, telephones, gas, and electric lighting or power works, factories, warehouses, fuel stores and stations, and other buildings, works, and conveniences, to acquire and turn to account any patents, rights, and inventions, to procure the company to be registered or recognised in accordance with the laws of British Colony or dependency, or any foreign country, to promote any other company for the purpose of acquiring all or part of the assets and liabilities of this company or otherwise, &c. The first subscribers (each with one share) are:—W. Hutchinson, 1, Great Winchester Street, E.C., gentleman; H. A. Plumb, 90, Cannon Street, E.C., chartered accountant; W. H. Dodgson, 26, Royal Exchange, E.C., stockbroker; H. F. Dodgson, 26, Royal Exchange, E.C., stockbroker; H. Caudle, 15, St. James's Road, Victoria Park, N.E., clerk; F. K. L. Butler, Glendale, Alexandra Park Road, Muswell Hill, N., clerk; and F. C. Crawley, 1, Great Winchester Street, E.C., secretary. No initial public issue. The number of directors is not to be less than two nor more than five; the first are J. Heaton, E. Clapham, W. Hutchinson, S. Rostron, and E. H. Woods; qualification of first directors, 200 shares; remuneration, £200 per annum, divisible. Registered office, 1, Great Winchester Street, E.C.

Marks & Hodgkinson, Ltd. (82,205).—This company was registered on October 5th, with a capital of £5,000 in £1 shares, to acquire the business of electricians and electrical engineers carried on by J. Marks and H. Clarkson, to adopt an agreement with J. Marks and W. B. Hodgkinson, and to carry on the said business and that of manufacturers of and dealers in electric lighting plant, apparatus and fittings, civil, mechanical and general engineers and contractors, &c. The first subscribers (each with one share) are:—J. Marks, 226, New John Street West, Birmingham, electrical engineer; W. B. Hodgkinson, Norwood House, Erdington, Birmingham, electrical engineer; W. L. Hodgkinson, Norwood House, Erdington, Birmingham, gentleman; Mrs. K. M. Hodgkinson, 77, Hagley Road, Edgbaston, Birmingham; Miss A. E. Hodgkinson, Norwood House, Erdington, Birmingham: H. R. Hodgkinson, 6, Bennett's Hill, Birmingham, solicitor; and J. H. Rice, Handsworth Wood, Birmingham, cashier. No initial public issue. The number of directors is not to be less than two nor more than five; the first are J. Marks, W. B. Hodgkinson and W. L. Hodgkinson (chairman); qualification, 50 shares; remuneration as fixed by the company.

Hughes' Atlas Works, Ltd. (82,329).—This company was registered on October 7th, with a capital of £1,000 in £1 shares, to adopt an agreement with the Industrial Bank, Ltd., and to carry on the business of gas and electrical engineers and fitters, manufacturers of gasaliers, chandeliers, electroliers and gas, and electric fittings and appliances generally, gas and oil lamps and lantern makers, brassfounders and finishers, metal workers, &c. The first subscribers (each with one share) are:—G. F. Davenport, 5, Colville Houses, W., director; J. Hobart, 35, Montrose Avenue, N.W., merchant; B. I. Davis, 22, Ryder Street, St. James's, S.W., merchant; W. H. Fen, Wymondley Parva, near Hitchin, Herts, F.C.A.; J. A. Norton, Hockley, Essex, agent; A. Hill, 58, Netherwood Road, West Kensington, W., clerk; and H. C. Parsons, 3, River Terrace, Sunbury, engineer. No initial public issue. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; remuneration, £50 each per annum (chairman £75), and 5 per cent. of the net profits after providing for debenture and other interest, divisible. Registered office, 9½, Union Court, Old Broad Street, E.C.

Scottish Electric Traction Co., Ltd. (5,705).—This company was registered in Edinburgh on October 6th, with a capital of £500, in 1s. shares, to promote, form, assist and establish companies, syndicates and associations for the purpose of carrying on any business or adventures of any description, whether relating to electrical enterprise or not, &c. The first subscribers (each with one share) are:—H. C. Anderson, 30, St. Andrew Square, Edinburgh, chartered accountant; R. Ritchie, 30, St. Andrew Square, Edinburgh, accountant; W. Swinden, 30, St. Andrew Square, Edinburgh, accountant; T. Williamson 9, York Place, Edinburgh, S.S.C.; G. Stewart, 37, Castle Street, Edinburgh, S.S.C.; J. Henderson, 37, Castle Street, Edinburgh, clerk; and G. Nicolson, 57, Castle Street, Edinburgh, clerk. Registered without articles of association.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Burnand Transformer Co., Ltd., Manchester (73,049).—£1,000 debentures, created August 31st, 1904, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees.

Otto Electrical Manufacturing Co., Ltd., Manchester (80,263).—Issue on September 1st of a debenture for £500, part of series created June 22nd, 1904, to secure £5,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: J. Deakin, The Hall, Wormhill, near Buxton. No trustees. Previously issued of same series: £1,500.

Moelline Co., Ltd., mechanical and electrical engineers, London (76,689).—Issue on August 31st of £250 debentures, part of series created May 29th, 1904, to secure £15,000, charged on the company's uncalled capital, present and future, and all property. Holder: City of London Contract Corporation, Ltd. No trustees. Previously issued of same series: £18,510.

Bowens Electric and Motor Boats, Ltd. (London), (81,645).—£4,000 debentures, created August 12th, and dated September 7th, 1904, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees.

British Electric Calibrated Fuse Co., Ltd. (78,488).—Issue on September 22nd of a debenture for £50, part of series created December 4th, 1903, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: J. Lang, 137, Fenchurch Street, E.C. No trustees. Previously issued of same series: £2,700.

Newmarket Electric Light Co., Ltd. (44,450).—Issue on September 19th, of a debenture for £100, part of series created October 16th, 1900, to secure £15,000, charged on the lands, buildings, machinery, works, plant, effects, and the company's undertaking and property, present and future, including uncalled capital. Trustees: G. H. Verrall, Newmarket, Suffolk; and F. E. Grippen, Broad Sanctuary Chambers, Westminster. Previously issued of same series: £14,100.

Dudley, Stourbridge and District Electric Traction Co., Ltd. (14,763).—An acknowledgement of indebtedness under seal, dated September 15th, 1904, acknowledging in respect of £10,000 further debenture stock, making indebtedness with £60,000 previously acknowledged £70,000, supplemental to a trust deed dated May 20th, 1904, securing debenture stock not exceeding half of the company's subscribed share capital for the time being, has been registered. Property charged: The company's assets, present and future. Trustees: Electric and General Investment Co., L'd., 1-2, Great Winchester Street, E.C.

ELECTRICITY SUPPLY ACCOUNTS.

Bury Municipal Electricity Supply.

The accounts of this Lancashire town contain, for the first time, a traction supply, which, however, is not at present sufficiently developed to benefit the undertaking. The returns obtained show, on the whole, the effects of trade depression in the district, and, under the circumstances, the engineer is to be congratulated on the satisfactory result of the year's working.

During the year large extensions of plant have been carried out, and the department is now in a position to meet the considerable traction and power load which it is anticipated will come on during the next year or two.

The following table of load factors is interesting as showing the conditions of supply at Bury; the traction load, however, is expected to reach 500,000 units per annum, and is, therefore, only in the initial stage; it also represents only 9½ months' working, principally on a short and hilly route.

	Units.	Max. load in KW.	Load factor.
Lighting	251,079	257·9	11·1 %
Power	299,538	119·6	28·5 %
Public lamps	54,664	19·8	31·4 %
Total light and power ...	605,281	397·3	17·3 %
Tramways...	67,630	90·0	8·5 %
	672,911	487·3	15·7 %

The supply for power purposes represents an increase of 112 per cent. on the previous year, and we are glad to note that the engineer recommends a reduction in the price of energy with a view to developing the output.

The prices charged are:—Private lighting, 6d. and 3d. on the maximum demand system, or 4½d. (flat rate) per unit; power, 3d. and 1d. maximum demand; and traction, 1½d. per unit; public arcs, £17 10s. per annum. The chief engineer and manager is Mr. S. J. Watson, M.I.E.E.

General Statement.

For year ending March 31st—	1904.	1903.
Total capital expended	£73,489	£59,240
Number of units sold—		
Private supply	550,617	369,411
Public lighting	54,664	55,582
Traction	67,630	—
Total number of units sold ...	672,911	424,993
Equivalent No. of 8-c.p. lamps connected...	38,095	35,647
H.P. of motors connected	470	458
Number of public lamps	34 arc, 18 inc.	34 arc, 17 inc.
Maximum load in KW.	487	319
Revenue account—		
Gross revenue	£8,105	£6,060
„ expenditure	£4,610	£2,981
„ profit	£3,495	£3,079
Average inclusive price obtained per unit—		
Private lighting	3·08d.	3·35d.
Public lighting	2·63d.	2·12d.
Traction	1·50d.	—

Revenue Account for Year ending March 31st, 1904.

Gross revenue	£8,105 =	2·89d. per unit.
Works and distribution costs (including public lighting)	£2,066 =	·74d. „
Total working costs	£4,610 =	1·65d. „

Profit Statement, 1904.

Interest on loans	£1,464
Sinking fund	1,465
Balance carried forward	566
Gross profit	£3,495

CITY NOTES.

Edison & Swan United Electric Light Co. (Limited and Reduced).

The twenty-first annual report for the business year ending June 30th, 1904, reads as follows:—"The net revenue account shows that the sum of £42,603 17s. 9d. has been brought forward from profit and loss account. Interest on debenture stocks has absorbed £18,760 18s. 4d.; £11,000 has been set aside as depreciation on freehold and leasehold property, plant, machinery, and tools; £1,442 13s. 11d. has been applied in writing down values of stocks; and the sum of £1,508 8s. has been reserved on account of bad and doubtful debts. A further sum of £1,000 has been added to the reserve for future stock depreciation. After providing for the foregoing, the result as shown in the net revenue account is a credit balance of £8,891 17s. 6d. At meetings of shareholders held on May 12th and 30th, 1904, a resolution was passed reducing the capital of the company by £2 10s. per share on each of the 23,564 "B" shares of the company. This resolution was duly confirmed by the Court on July 26th. Effect has been given to it in the account as now presented. As a result of this writing down of capital a debit balance of £3,589 14s. 7d. remained, and deducting this from the balance of £8,891 17s. 6d. as mentioned above, leaves a credit balance of £5,302 2s. 11d. to be carried forward. Cost of establishing the business, goodwill, &c., £443,451 8s. 1d., has been brought forward at the figures standing in the last balance-sheet. The freehold and leasehold property, plant, machinery, and tools have also been brought forward at the value stated in the last balance-sheet, with the addition of the amount expended to June 30th, 1904, less depreciation charged in net revenue account. There has been expended on capital during the year ended June 30th, 1904, £1,029 7s. The shares of the Altrincham Electric Supply, Ltd., have been taken at par, as in previous years. The indebtedness of this company has been reduced during the year by £1,466 10s. 1d. Mr. E. B. Ellice-Clark retires in rotation, and offers himself for re-election."

The meeting is to be held at Winchester House, E.C., on Monday next, 17th inst.

Norwich Electric Tramways Co.

The report for the year ended June 30th last, to be presented at the meeting on 12th inst., states that the earnings show an increase over those of the previous year, traffic receipts having amounted to £34,720, against £33,516 in 1903. The result of the year's working is a gross profit of £10,768, to which has to be added £201 interest received and £1,213 brought forward. Deducting from this £2,640, being 4 per cent. interest to June 30th, 1904, on the outstanding mortgage debentures, and £1,012, which the directors have placed to reserve account, there remains a profit of £8,529. The directors recommend that a dividend of 3 per cent. be paid on the shares for the year, leaving £609 to be carried forward. The reserve will then stand at £3,197. The operating expenses for the year show an increase of £85. The number of passengers carried was 7,461,718, and the number of car-miles run was 1,088,951.

The eighth annual ordinary general meeting was held at 20, Bishopsgate Street, E.C., on Wednesday, under the chairmanship of Baron E. B. d'Erlanger.

The Chairman moved the adoption of the above report, and said it would be seen that satisfactory progress had been made for the year ending June 30th, 1904, and that the receipts had shown a satisfactory expansion, although the progress was not as rapid as they might desire. Still, taking into consideration the bad state of trade all over the country, and especially in the Eastern counties, it was satisfactory to know that their net income had exceeded the net income of the year before. It had allowed them to pay a dividend of 3 per cent. instead of a dividend of 2½ per cent., and they hoped they would maintain that improvement in the future. They had put £1,200 to reserve fund, which now reached £3,100, some of which was invested in the business. They hoped, however, to get a strong reserve apart from the business, although some might be invested in the debentures of the company.

The Hon. A. G. Brand, M.P., seconded the motion, and the report was carried.

South Lancashire Electric Traction and Power Co.

In Liverpool on the 7th inst., the Hon. Arthur Stanley, M.P., presided over the fourth ordinary general meeting of this company.

The Chairman moved the adoption of the report, and said they were asked to pass a resolution for the voluntary liquidation, so as to facilitate the reconstruction of the company, and to ensure that the interests of the creditors and shareholders would be looked after. Mr. Eshelby, of Harwood, Banner & Son, was selected to carry out the liquidation. The chairman proceeded to say that in the matter of interurban communication, the company were in the position of pioneers, and had the satisfaction of knowing they had conferred immense benefit on the neighbourhood, especially upon the working classes, by cheapening the means of transit.

The Hon. Arthur Stanley, M.P., and Mr. C. E. Maples, were re-elected directors of the company, and Messrs. Chalmers, Wade and Co. were re-elected auditors.

The resolution approving of the balance-sheet to June 30th last, was carried, and at a subsequent extraordinary meeting, the resolution for voluntary liquidation was carried.

The following circular has just been issued:—"We beg leave to inform you that by an order of the Palatine Court, dated July 6th, 1904, we have been appointed receivers and managers of the undertaking of the South Lancashire Electric Traction and Power Co., Ltd. We enclose for your information the balance-sheet as at June 30th last, and any further information with regard to the affairs of the company may be obtained by application to Mr. J. R. Salter, of this address, or to Mr. J. M. Henderson, of 2, Moorgate Street Buildings, London, E.C.

"The business is being continued by us, and all goods supplied and work done under our authority, will be paid for in the ordinary course.

"J. R. Salter, } *Joint Receivers*
"J. M. Henderson } *and Managers.*"

Cuba Submarine Telegraph Co.

The directors' report for the half-year ending June 30th, 1904, to be presented at the meeting to be held on 19th inst., reads as follows:—

The total receipts of the six months were £18,715 15s. 6d., while the expenses including the cost of the attempted repair of the Cienfuegos-Santiago 1875 cable) amounted to £14,039 12s. 9d., leaving a balance of £4,676 2s. 9d., to which has to be added £6,970 19s. 8d. brought forward from last account, giving a total of £11,647 2s. 5d. to be dealt with. The dividend on the preference shares will absorb £3,000, and leave £8,647 2s. 5d., out of which the directors recommend the payment of a dividend at the rate of 5 per cent. per annum on the ordinary shares, free of income-tax; the balance, £4,647 2s. 5d., being carried forward to the current half-year. The payments to June 30th on account of the Cienfuegos-Santiago new cable have been charged to the reserve fund, which now stands at £144,982 1s. The directors regret to report that the Cape Cruz-Santiago section of the Manzanillo-Santiago cable became interrupted on June 14th. The West India and Panama Telegraph Co.'s cable steamer *Henry Holmes* has been hired for the repair, and is now at work on the cable. This interruption accounts for the falling off in the receipts during June. The applications to the United States Government for payment of the claim for the cost of repairing the damage done to the cables during the Spanish-American war, and to the Cuban Government for payment of the subsidy for the coast cables, are still unsettled.

Official Announcements re Companies.

The names of the undermentioned companies have been struck off the register:—

British & Foreign Tramways Co., Ltd.
East Suffolk Tramways Co., Ltd.
Electro-Stannus Co., Ltd.
Gramme's Magneto-Electric Co., Ltd.
Kew, Richmond & Kingston Tramways Co., Ltd.
Madras Electric Tramways Co., Ltd.
Swansea Tramways & Improvements Co., Ltd.
Tramway Wheel Plant & General Foundry Co., Ltd.

Indo-European Telegraph Co.—The directors have declared an interim dividend for the half-year ended June 30th last, at the rate of 5 per cent. per annum, free of income-tax, payable on and after November 1st next.

Anglo-American Telegraph Co.—After placing £5,000 to the credit of the renewal fund, the board has resolved to declare an interim dividend for the quarter ending September 30th, 1904, of 12s 6d. per cent. on the ordinary stock, and £1 5s. per cent. on the preferred stock, less income-tax.

STOCKS AND SHARES.

Wednesday Evening.

Again it is a pleasant duty to have good Stock Exchange business to report. Notwithstanding the rise in the Berlin Bank Rate, with its instant corollary of talk as to an advance in the Bank of England minimum, the purely investment departments are nearly all steadily firm. Consols at first lost ground, and with them went the prices of their immediate following. More money will manifestly be required before long by several heavy borrowers, and the developments in the Extreme East seem to hasten the time when Japan must want another big loan. But outside the circle of the more sensitive investment stocks the general tone, as already indicated, is good, and business begins to establish itself upon a much better basis of free buying and selling. How long it may last is a question best left to the future for decision, and we prefer to postpone our prophecy until we know.

While there has been a slight recession amongst some of the gilt-edged stocks of the electricity supply division, telegraph prior-charges have once more hardened. Both the Eastern and South African Telegraph Debentures have risen a point, and so has Direct West India 4½ per cent. Debenture. Halifax and Bermudas Cable 4½ per cent. bonds are a similar sum higher, and the two latter appear to be well enough secured to make them good investments. Unhappily, there is not much market in either.

Anglo-American Telegraph Deferred has dropped to 8⅛, and the dividend announcement is decidedly disappointing, although it did not quotably effect the price of the Preferred and Ordinary stocks. It was thought that the company would certainly be able to declare a dividend of 15s. on the Ordinary, making 30s. on the Preferred, but the actual figures are only 12s. 6d. and 25s. respectively. This means that the Preferred stock is still 10s. per cent. underpaid for the half-year, it having received 50s. instead of £3 in the last six months. There is also a 10s. fall in the price of Great Northern of Copenhagen shares, bringing them down to 29 middle. On the other hand, Eastern Ordinary is somewhat better at 134½, and Submarines have added a point.

Of Tramway descriptions, Buenos Ayres and Belgrano Ordinary stand out prominently in point of activity, and a fresh rise of 7s. 6d. has carried the price to 4. The good traffics, and the favour with which Argentine traction properties have lately come to be regarded, are the two principal reasons for the advance, added, of course, to the interim dividend and the outlook for the final distribution. The "A" and "B" Preference remain at 5⅝ and 5¼ respectively, while the First Debenture stock stands at 106½, and the Second Debenture at 103½. The Preference shares carry a 6 per cent. cumulative dividend, and the Debentures receive 5 per cent. interest. Quite possibly the rise in the Ordinary has been rather too rapid to stay. Anglo-Argentines, for once, present no change, and City of Buenos Ayres are 10½. London United Preference at 10⅜, and the Debenture stock at 104, are both quiet. There is a small demand for London Road Car shares, possibly stimulated by the appearance of a new type of electric 'bus that has just started running between Hammersmith and Oxford Street. Brisbane Electric Preference are a shade firmer at 4 1/16, and Calcutta Tramways Debenture has been done at 106¾. A ¼ improvement in British Electric Traction Ordinary brings the price to 10, the par value of the shares. British Westinghouse Preference are 3, the Debenture stock 87½, and British Thomson-Houston Debenture 101. Auckland and Metropolitan Tramways Debentures are both 1 up at 104 and 101. Urban Debenture at 101 is officially quoted for the first time this week.

In the Railway market, Great Northern and City Preferred are 5s. up, to 5½, and East London provided a diversion the other day, when rails were weak, by soaring to 5, business being marked at 5¼. Mersey stock sticks at 7½, but as a long-shot, it might be worth attention. Districts have been weaker, and slipped back to 42, whereas, by rising to 97½, Metropolitans shook themselves free from the prevailing dulness, the Surplus Lands stock being 76. Underground profit-sharing notes changed hands at 98¾ on Tuesday.

Metropolitan Electric Supply shares are not, of course, affected by the London County Council's loan to the Marylebone Borough Council of £1,415,000 for the purchase of the electric light undertaking. In fact, the Supply list as a whole is somewhat uninteresting from its lack of alterations. Bromptons fell ¼ to 10⅜, and Charing Cross are ¼ up at 8⅜, the movements reflecting a few orders which have come to market. Kensington 4 per cent. Debenture lost a point at 102½. St. James's 3½ per cent. Debenture stock is quoted at 99½, and perhaps the paucity of supply of such securities may shortly be augmented by the appearance of another important issue. The better report of the Edison & Swan Co. has produced no change in the price of the shares or prior stocks, but Brush First Debenture shed a point at 94½. County of London have risen ½ to 9, and Westminster Preference ¼ to 6¼.

Henley's Debenture and Callender's Debenture are both a little harder. No improvement has come to Willans & Robinson shares. Babcock & Wilcox maintain their prices, and, as regards Telephone issues, there is nothing of moment to report. The student of such matters will note with interest that in this week's offer of Cape Town 4 per cent. stock, one of the assets upon which the loan is secured, figures as £224,440 for the electric light installation of that city.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME,	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations Oct. 5th.	Closing Quotations Oct. 12th.	Business done week ended Oct. 12th, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¼ — 8½	2¼ — 8½	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	50 — 53	50 — 53	50½	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	96 — 98	96 — 98	98½	97
3,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	8½ — 8¾	8 — 8½	8⅞	8⅞
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	7 %	5 — 5½	5 — 5½	5⅝	..
18,383,800$	Commercial Cable	$100	8 %	8 %	..	170 —190 xd	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	93 — 96 xd	93 — 96	94	93⅜
16,000	Cuba Telegraph	10	4 %	6½%	5 %	7 — 8	7 — 8	7⅜	..
6,000	Do. 10 % Pref.	10	..	..	..	15 — 16	15 — 16	..	..
6,000	Direct Spanish Telegraph10 % Cum. Pref.	5	..	..	..	7 — 8 xd	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	98 —101 %	98 —101⅛	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3 %	10½ — 10⅝	10½ — 10⅝	..	..
81,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —101	100 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	130 —135	132 —137	136	132
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	87 — 90	87 — 90	89¼	88
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	108	106½
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12½ — 13	12½ — 13	13	12¹¹/₁₆
890,000£	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	105 —108	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	99 —102	100 —103	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —103 %	100 —104	101½	100½
180,227	Globe Telegraph and Trust	10	5½%	£3 16 7*	5½%	9¼ — 9⅜	9¼ — 9⅜	9⅜	9⅜
180,042	Do. do. 6 % Pref.	10	..	..	..	13½ — 14½	13½ — 14½	13⅝	13½
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	29 — 30	28½ — 29½	..	..
54,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,900, Red.	100	..	..	..	99 —101	100 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	44 — 47	44 — 47	45	..
72,680	Monte Video Telephone Co, Ltd., Ord.	1	..	..	..	1/16 — 1/8	1/16 — 1/8	..	..
1,988,888	National Telephone, Pref. Stock	100	5 %	6 %	6 %	104 —106	104 —106	105¾	104½
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	92 — 94	92 — 94	93¼	92¼
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	13⅜	13⅜
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	11⅜	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼ — 5⅜	5¼ — 5⅜	5 5/16	5⅛
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 — 99	97 — 99	98½	..
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	104 —106	104 —106	105¼	..
1,000,000	Do. do. Prov. Certs., 35 % to be paid	..	..	..	..	67 — 69	67 — 69	67½	..
179,318	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6½%	1⅜ — 1⅝	1⅜ — 1⅝	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1⅛ — 1½	1⅛ — 1½	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6¾ — 7⅛	6¾ — 7⅛	7	..
8,808	Submarine Cables Trust	Cert.	..	..	..	118 —123	118 —123	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	6 — 6⅛	6 — 6⅛	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅜ — 5⅛	4⅜ — 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	103 —106	103 —106	..	..
15,609	West African Telegraph, Shares	10	..	2 %	4 %	6 — 7	6 — 7	..	..
30,008	West Coast of America, 1 to 30,000 and 53,001 to 53,009	2½	..	..	..	1/16 — 1/8	1/16 — 1/8	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	..	..	..	97 — 100	97 —100	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	12½ — 13	12½ — 13	12¹⁵/₁₆	12¾
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	101 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	101 —104	101 —104	102¾	..
88,321	West India and Panama Telegraph	10	..	..	..	⅜ — ½	⅜ — ½	7/16	..
94,568	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6½ — 7	6½ — 7	7	6⅞
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	5 — 6	5 — 6	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,900	100	..	..	..	100 —103	100 —103	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	5 — 6	5 — 6	5⅛	5¹¹/₁₆
10,000	Do. do. "A" 6 % Cum. Pref.	10	..	..	..	8½ — 9½	8½ — 9½	..	..
800,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	94 — 98	94 — 98	95½	..
100,000	British Electric Traction	10	9 %	8 %	..	9½ — 10	9⅜ — 10⅜	10 1/16	9⅜
100,000	Do. do 6 % Cum. Pref.	10	..	..	..	10⅜ — 11⅛	10⅜ — 11¼	11⅛	10⅜
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	115 —118 xd	115 —118	117⅜	117½
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	96 — 97	94 — 97	95½	..
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5½ — 6	5½ — 6	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅝ — 6	5⅝ — 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	101 —104	101 —104	..	..
50,000	¶Brown, Lindley & Co., Ord.	£1	Nil	..	..	1/16 — 1/8	1/16 — 1/8	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781	2	Nil	Nil	Nil	½ — ¾	½ — ¾	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	1 — 1½	1 — 1½	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	94 — 97	93 — 96	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	70 — 75	70 — 75	..	..
85,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	9½ — 10½	9½ — 10½	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5½	5 — 5½	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	101 —105	102 —105	104	103½
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	87 — 90	87 — 90	..	..
494,098	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	100 —102	100 —102	102	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	79 — 81	79 — 81	..	..
1,380,000	City and South London Railway	Stock	2 %	2½%	2½%	47 — 49	47 — 49	47⅞	47½
85,000	Crompton & Co., Nos. 1 to 85,000	3	7½%	5 %	..	1½ — 2	1½ — 2	1 1/16	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	90 — 95	90 — 95	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	⅜ — ¾	½ — ¾	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	Nil	..	1 — 2	1 — 2	..	..
44,028£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	77 — 82	77 — 82	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	78 — 83 xd	77 — 82	..	..
12,100	Electric Construction 1 to 112,100	2	6 %	6 %	4 %	1 — 1⅛	1 — 1⅛	1 1/16	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	..	..	..	2 — 2¼	2 — 2⅛	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	96 — 99	96 — 99	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9 — 9⅛	9 — 9⅛	9⅛	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	91 — 96 xd	91 — 96	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	10⅜ - 11⅛	10⅜ — 11⅛	..	..
200,000	Do. do. 4½ % Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111	108 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	19 — 20	19 — 20	..	..
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	99 —102 xd	99 —102	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	3⅜ — 3⅝	3⅜ — 3⅝	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10⅜	10 — 10⅜	..	..
37,850	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	35 — 38	36 — 39	37½	36
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3½%	3½%	£6 — 89	86 — 89	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st 1904).

SHARE LIST OF ELECTRICAL COMPANIES (continued) — ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME,	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations Oct. 5th.	Closing Quotations Oct. 12th.	Business done week ended Oct. 12th, 1904. Highest.	Lowest.
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	†							
20,000	Do. do. 7 % Cum. Pref. ..	£5	8%	8 %	10 %	10⅜— 11¼	10½— 11	10 13/16	10⅜
250,000	Central Electric Supply 4 % Guar. Deb. Stock	£5				10¼— 10⅜	10¼— 10⅜	..	..
50,000	Charing Cross and Strand Electricity Supply	£100				107 —110	107 —110	..	..
70,000	Do. do. 4½% Cum. Pref. ..	£5	10 %	10 %	8 %	8¼— 8⅝	8¼— 9	8 5/16	8 5/16
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	£5				5⅛— 5⅜	5⅛— 5⅜	5 7/16	5 5/16
40,000	Do. do. 1903	£5				4⅜— 5	4⅜— 5	..	..
250,000	Do. do. 4 % Deb. Stock Red.	£100				4⅜— 5	4⅜— 5	..	..
44,486	*Chelsea Electricity Supply, Ord.	£5	4 %	4½%	5¼%	103 —105	103 —105	104	..
150,000	Do. do. % Deb. Stock Red.	Stock				6¾— 7	6¾— 7	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	£10	5 %	5 %	5 %	108 —111	108 —111	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£10				10½— 10¾	10½— 10¾	10½	..
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid ..	£				13 — 14	18 — 14	18 3/4	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid ..	£100				120 —125	120 —125	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£10	4 %	4 %	4 %	103 —106	103 —106	105¼	105
30,000	Do. do. do. 6 % Pref., 40,001—60,000..	£10				8 — 9	8½— 9½	8 7/8	8 13/16
400,000	Do. do. 4½% Deb. Stock	£				11¼— 12	11¼— 12	..	..
950,000	Do. do. 4½% 2nd Deb. Stock	Stock				105 —108	105 —108	..	..
70,000	Edmundson's Electric Corporation, Ord. Shares	£5	7 %	7 %	7 %	102 —105	102 —105	..	..
70,000	Do. do. 6 % Cum. Pref.	£				6¼— 6⅝	6¼— 6⅝	6 5/8	6 5/8
300,000	Do. do. 4½% 1st Mort. Deb. Stock ..	£100				6 — 6¼	6 — 6¼	6 5/8	6 5/8
21,000	Kensington and Knightsbridge Electric Ord.	£5	10 %	10 %	12%	105 —108	105 —108	..	..
90,000	Do. do. 4 % Debenture Stock ..	£				12 — 13	12 — 13	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	Stock				102 —105	101 —104	..	..
49,840	Do. do. 6 % Pref.	£8				1⅞— 2⅛	1⅞— 2⅛	..	..
250,000	Do. do. 4 % 1st Mort. Deb. Stock Red	£5				5 — 5⅛	5 — 5⅛	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	Stock				97 — 99	97 —100	..	..
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	£10	6½%	7½%	8⅔%	15⅞— 16¼	15⅞— 16¼	16⅛	..
220,000	Do. do. 4½% 1st Mort. Deb. Stock	£5				5⅜— 5⅝	5⅜— 5⅝	..	..
250,000	Do. do. 3½% Mort. Deb. Stock Red	£				112 —117	112 —117	..	..
10,852	Notting Hill Electric Lighting	Stock				96 — 99	96 — 99	98½	..
59,000	Do. do. 4% 1st Mort. Deb.	£10	6 %	6 %	6 %	14½— 15½	14¼— 15½	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£100				99 —102 xd	99 —102	..	..
30,000	Do. do. do. 7 % Pref. 20,081 to 40,080	£5	14½%	14½%	14½%	14½— 15½	14½— 15½	15 1/2	..
150,000	Do. do. do. 3½% Deb. Stock Red ..	£5				8 — 9	8 — 9	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£100				98 —101 xd	98 —101	..	..
50,000	Do. do. 4 % Deb. Stock	£5		2½%	4 %	2⅜— 3⅛	2⅜— 3⅛	..	..
65,000	South London Electricity Supply. Ord.	£				83 — 87	83 — 87	..	..
100,000	South Metropolitan Electric Light and Power Ord.	Stock		1½%	8 %	4¼— 4⅜	4¼— 4⅜	4½	4⅜
50,000	(Late Blackheath and Greenwich 7 % Pref.	£5				⅞— 1	⅞— 1	..	..
100,000	Dist. E.L.Co.) 4½% 1st Deb. Stock	£1				1⅛— 1⅛	1⅛— 1⅛	..	..
80,000	Urban Electric Supply, Ord.	£100				104 —108 xd	104 —108	..	..
80,000	Do. do. 5 % Cum. Pref.	£5				4⅜— 5 xd	4⅜— 5	4 31/32	4 15/16
110,000	Westminster Electric Supply, Ord.	£5				4⅜— 5 xd	4⅜— 5	4 7/8	..
28,141	Do. do. 5 % Cum. Pref.	£5	10½%	12 %	13½%	12¼— 13⅛	12¼— 13⅛	13 1/8	12⅜
						6 — 6¼	6¼— 6⅜	..	..

*Subject to Founders Shares. † Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS. Wednesday, October 12th

	CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	82/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ,, ...	per ton	£30	..
a	Bleaching powder	per ton	£4 10	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£13	..
a	Benzole (90 %)	per gal.	7/-	..
a	,, (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£19	..
a	Lead, Nitrate	per ton	£25	£5 dec.
a	,, White Sugar	per ton	£31	..
a	,, Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a	Potash, Bichromate, in casks ..	per lb.	8d.	..
a	,, Caustic (75/80%).. ..	per ton	£24	..
a	Shellac	per cwt.	210/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda. Caustic (white 70 %) ..	per ton	£10 15	..
a	,, Crystals	per ton	£8	..
a	,, Bichromate, casks.. ..	per lb.	2½d.	..

	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£180	..
b	,, Wire, in ton lots ..	per ton	£168	..
b	,, Sheet, in ton lots ..	per ton	£166	..
b	Babbitt's metal ingots	per ton	£48 to £130	..
c	Brass (rolled metal 2' to 12') basis	per lb.	6¼d.	..
	,, Tube (brazed)	per lb.	8¼d.	⅛d. inc.
c	,, ,, (solid drawn).. ..	per lb.	7⅛d.	⅛d. inc.
c	,, Wire, basis..	per lb.	7d.	⅛d. inc.
c	Copper Tubes (brazed)	per lb.	9⅛d.	⅛d. inc.
c	,, ,, (solid drawn) ..	per lb.	9⅛d.	⅛d. inc.
c	Copper Bars (best selected	per ton	£74	£3 inc.

	METALS, &c. (continued).		Latest Price.	Week's Dec. or Inc.
g	Copper Sheet	per ton	£74	£3 inc.
g	,, Rod	per ton	£74	£3 inc.
e	,, (Electrolytic) Bars ..	per ton	£64	£2 inc.
e	,, ,, Sheets ..	per ton	£80	£2 inc.
e	,, ,, Rod	per ton	£74	£3 inc.
e	,, ,, H.C. Wire	per lb.	8¼d.	⅛d. inc.
f	Ebonite Rod	per lb.	3/8	..
f	,, Sheet	per lb.	8/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	8/-	..
h	India-rubber, Para fine	per lb.	4/9 to 4/10	1d. inc.
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	43/7½	2½d. inc.
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£12 2 6 to £12 3 9	1/8 to 3/6 dec.
g	,, ,, Sheet	per ton	£11 17s. 6d.	..
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£7 15	..
d	Mica (in original cases) small ..	per lb.	6d. to 1/	..
d	,, ,, ,, medium	per lb.	2/6 to 4/-	..
d	,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p	,, rolled bars & rods	per lb.	1/- to 1/8	..
p	,, ,, strip & sheet	per lb.	From 1/1	..
o	Platinum	per oz.	£4	..
e	Silicium Bronze Wire	per lb.	9d. to 11d.	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£131 to £120	£1 inc.
g	,, Foil	per lb.	1/6	..
n	,, Wire, Nos. 1 to 16	per lb.	1/8	⅛d. inc.
p	White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £62	..
j	Yarns, 2/10s Grey Cotton, on sp'l's	per lb.	8d.	..
j	,, 6 lea. Flax	per lb.	5¾d.	..
j	,, 8 ply 10 lbs. Russian ..	per lb.	4½d.	..
j	,, 10 lbs. Russian, single ..	per lb.	4½d.	..
j	,, 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh'ts (Vieille Montagne brd.)	per ton	£25 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co., *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS

Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Aberdeen	Oct. 8	1,320	+180	19	30,454	+ 5,583	10	—
Bath	,, 5	676	—	41	26,041	—	12½	—
Birmingham ..	,, 8	5,526	+213	41	220,501	+11,966	3½	—
Blackburn	,, 7	957	+10	25	27,532	+ 2,817	13½	—
Blackpool	,, 6	873	+ 209	27	99,093	+ 5,513	8½	—
,, —Fleetw'd	,, 8	459	+ 30	14	18,583	+ 180	7½	—
,, —Lytham	,, 6	318	— 11	49	19,736	+ 7,921	7½	—
Bolton	,, 2	1,844	— 28	27	51,224	+ 450	25	—
Bournemouth ..	,, 5	1,060	+ 87	27	32,829	—	10½	—
Bradford	,, 1	4,888	+943	26	125,872	+22,586	50	—
Brighton	,, 9	968	+111	—	30,615	—	9	—
Bristol	,, 7	5,180	+167	—	—	—	28	—
Devonport ..	Sep. 30	525	— 7	39	21,190	+ 3,316	5	—
Dudley—Sto'rb'ge	,, 30	952	+ 47	39	34,628	+ 1,391	18½	—
Gateshead ..	,, 30	1,010	+ 49	39	35,628	+ 1,546	10½	+ ½
Gr'n'k—Pt. Glsgw	,, 30	662	+ 26	39	22,941	+ 1,192	7½	—
Oldham—Ashton	,, 30	554	— 41	39	21,669	— 983	8	—
Potteries	,, 30	1,774	+ 37	39	66,803	+ 5,276	28½	—
South Staffs. ..	,, 30	729	—337	39	30,117	— 5,871	21½	—½
Swansea	,, 30	545	+ 11	39	21,645	+ 1,010	5½	—
Wolverhampton..	,, 30	380	— 22	39	15,463	— 39	10½	+8
Yorks. Wool Dist.	,, 30	493	— 8	39	23,475	+ 8,721	6	—
Miscellaneous ..	,, 30	3,833	—	39	145,141	—	—	—
Burnley	Oct. 8	1,140	+314	—	—	—	10½	+2½
Burton-on-Trent ..	,, 9	368	— 47	27½	10,146	—	8½	—
Cardiff	,, 1	2,065	— 3	26	56,193	+ 1,862	14	—
Chatham & District	,, 6	683	+ 4	40	28,945	+ 2,143	8·59	—
Cork	,, 6	505	— 54	40	19,027	— 2,463	9·99	—
Dover	,, 8	207	— 17	40	9,015	— 801	8	—

Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Dublin	Oct. 7	4,911	— 68	—	76,985	— 3,440	47	+ ½
East Ham	,, 10	665	— 2	27	20,384	+ 1,414	6½	—
Glasgow	,, 8	14,737	+646	19	271,911	+15,561	71½	+5½
Halifax (2 weeks) ..	,, 5	2,830	+ 34	27	43,006	+ 3,416	33	+1½
Huddersfield ..	,, 8	1,249	— 3	27	38,934	+ 2,641	28	—
Hull	,, 8	2,091	+126	27	59,443	+ 7,609	13	+2½
Ilkeston	,, 6	135	— 37	27	4,071	—	3·5	—
Ipswich	,, 8	445	—	27	14,747	—	10½	—
Isle of Thanet ..	,, 8	481	+ 6	40	31,358	+ 1,590	10½	—
Leeds	,, 8	5,741	+318	27	167,400	+10,065	89	+9
Liverpool	Sep. 24	10,684	—388	39	404,803	+12,214	103	—
London C. C. ..	Oct. 1	13,642	+2725	26	389,299	+70,489	471½	+7½
Manchester	,, 8	12,364	+649	27	339,926	+13,984	137½	+12½
Newcastle	,, 8	3,594	—147	—	—	—	17	—
Portsmouth	,, 8	1,753	+ 49	—	59,668	+ 4,848	14½	—
Salford	,, 8	4,115	+ 81	26	111,043	+ 7,293	30	—
Sheffield	,, 9	4,622	+230	28	133,268	+ 2,939	34½	+1½
Southampton ..	,, 6	982	— 19	27	28,272	— 1,918	9	—
Southend-on-Sea ..	,, 5	315	+ 19	27	11,618	+ 1,240	6½	—
Sunderland	,, 2	1,216	— 2	27	35,417	+ 390	21	+1
Tyneside	,, 5	386	+ 29	40	15,841	+ 2,614	8·9	+·4
West Ham	,, 6	1,088	—	32	29,477	—	9·78	—
Wolverhampton ..	,, 5	729	+254	—	—	—	9·5	—
Cen. London Rly. ..	,, 8	5,751	+247	14	83,771	— 581	6	—
City & S. Lon. Rly.	,, 9	2,768	+ 19	15	36,210	+ 1,112	6½	—
Dublin—Lucan Rly.	,, 7	130	— 14	14	2,013	— 30	6½	—
G. N. and City Ry.	,, 8	1,177	—	34	32,940	—	3½	—
L'pool Overh'd Rly.	,, 9	1,504	— 58	15	24,616	— 923	6½	+½
Mersey Railway ..	,, 8	1,548	+202	14	20 318	+ 1,553	4½	—

* Compared with the corresponding period of 1903.

ELECTRICAL LAW IN THE COLONIES AND INDIA.

[FROM OUR LEGAL CONTRIBUTOR.]

(*Continued from page* 599.)

VII. *India.*—The supply of electricity for traction or any other purpose in India is regulated by the Indian Electricity Act (III. of 1903). That statute is divided into parts which are entitled as follows :—(1) Preliminary ; (2) supply of energy to the public ; (3) restrictions on use of energy not supplied under Part (2) ; (4) general. It concludes with a lengthy schedule which embodies many of the clauses comprised in the Electric Lighting (Clauses) Act of 1899.

The Act extends to the whole of British India, inclusive of British Baluchistan and the Lanthal Parganas, and comes into force on such date as the Governor-General in Council may direct by notification in the *Gazette of India*. The following is an epitome of Part 2, which regulates the

Supply of Energy to the Public.—It is provided (by Sec. 3) that "No person shall supply energy for electric traction, or to the public for any purpose, except under and in accordance with the terms and conditions of a licence granted by the Local Government under this Part." To this rule there is an exception which prevents the section applying to any railway or tramway which is subject to the provisions of the Indian Railways Act, 1890. If any dispute arises as to whether energy is, or is not, to be supplied for electrical traction, or to the public for any purpose within the meaning of this section, the matter is referred to the Local Government, whose decision is final.

With reference to this Section, it should be observed in passing that there is an essential difference between the law of electric lighting in India and that which prevails in England.

In England it is competent for any person to supply electricity to the public without Parliamentary or other sanction; a provisional order merely confers exceptional rights and privileges. In India, however, it seems that energy in this form cannot be supplied except under license (as to supply under Part 3, see *Post*).

Grant and Revocation of Licenses.—This is regulated by Sec. 4. The Local Government may grant licenses to supply energy for any purpose in any specified area, and may also permit cables to be laid upon certain terms, of which the following is the substance. Before granting the license they are to take the sense of every local authority concerned, and to give proper effect to any objections which may be lodged by such local authority. The application for the license must be published and advertised in such manner as the Governor-general in Council shall direct. No application for a license shall be made by a *local authority*, except in pursuance of a resolution passed at a meeting of such authority held after one month's previous notice of such meeting has been given. A license granted by the Local Government may prescribe the terms and limits under which a supply shall be compulsory or permissive, and may prescribe the limits of prices. The grant of a license in a particular area shall not hinder or restrict the grant of another license to another person within the same area of supply for a like purpose, and a license may be revoked in any of the following cases, *inter alias*:—(*a*) Where the licensee makes default in doing anything required to be done by him ; (*b*) where the licensee breaks any terms of the license, the breach of which renders it liable to be revoked ; (*c*) where the licensee, not being a local authority, fails within a period of six months after the date of his license to show to the satisfaction of the Local Government that he is in a position fully and efficiently to discharge the duties and obligations imposed on him by his license, or fails to make the deposit or furnish the security required by his license ; (*d*) where the licensee is insolvent ; (*e*) where the licensee, not being a local authority, shows to the satisfaction of the Local Government that the undertaking cannot be carried on at a profit.

Provision is also made for the revocation of a license if the licensee desires it, and has obtained the consent of the local authority. Instead of revoking a license outright, the Local Government may also permit to remain in force for a limited time subject to special condition.

When the license of a licensee (not being a local authority) is revoked, the Local Government are empowered (by Sec. 5) to serve a notice of such revocation upon the licensee. Any local authority may then, with the permission of the Local Government, purchase the undertaking or such part thereof as is carried on within their area. The price is to be determined (in case of difference) by arbitration. It is to be fixed according to the principles which are analogous to those laid down in the English Electric Lighting Act, 1888, Sec. 2, by which a local authority is empowered to purchase an electric light undertaking after the lapse of a number of years. The value of the lands, buildings, machinery, &c., is to be the fair market value at the time of working, regard being had to their state of repair, and to the fact that they are in such a condition as to be fit for immediate working. There is no compensation, however, for compulsory purchase or loss of goodwill.

If the local authority do not elect to purchase, the Local Government may (by Sub-sec. (*c*)) sell the undertaking to another person, or (by Sub-sec. (*d*)) purchase it themselves.

When the license of a *local authority* is revoked, the Local Government may forthwith cause the works to be removed, and the streets to be reinstated, the cost of such works to be charged to the licensee.

Compulsory Purchase.—Sec. 7 provides for compulsory purchase of an undertaking by the local authority after the expiration of 42 years from the date of the license. The terms of purchase are practically identical with those set out in Sec. 2 of the Electric Lighting Act, 1888. If the local authority do not elect to purchase, the Local Government may purchase the undertaking or any part thereof. There is also a useful provision to the effect that if the local authority merely elect to purchase that portion of the undertaking which is within their area, the Local Government may purchase the remainder. (Sub-sec. 3.) Twelve months' notice in writing must be given by the local authority of their intention to exercise the power of compulsory purchase. They are not, however, bound to exercise such right, but may enter into a working agreement with the licensee.

A licensee must not, without the consent of the Local Government, purchase or associate himself with other licensed undertakings, or transfer his undertaking to any other person. Any agreement to this effect made without such consent shall be void.

Varying the Terms of Purchase.—Sec. 10 embodies a principle which we should be glad to see more frequently introduced. It is there provided that notwithstanding the provisions already considered with regard to compulsory purchase, the Local Government may, with the sanction of the Governor-General in Council, vary the terms upon which a licensee shall be bound to sell his undertaking.

Annual Accounts.—Every licensee must render accounts relating to his undertaking to the Local Government.

Opening and Breaking-up of Streets, &c.—Sec. 12 provides that any licensee may, subject to the terms and conditions of his license (*a*) open and break up the soil and pavement of any street, railway, or tramway within the area of supply ; (*b*) open and break up any sewer, drain, &c., under such street, &c. ; (*c*) lay down and place within the area of supply electric supply lines and other works ; (*d*) repair, alter, or remove the same ; and (*e*) do all other acts necessary for the due supply of energy within the area of supply.

The special provisions relating to the execution of works which provide for the giving of notices to local authorities are so very similar to English provisions that they need not be referred to in particular.

Aerial Lines.—Sec. 17 makes special provision for the erection of aerial lines. It provides that "Nothing in this part shall be deemed to authorise or empower a licensee to place any aerial line along or across any street unless and until the Local Government, after consulting the local authority, has communicated to him a general approval, in writing, of the methods of construction which he proposes to adopt."

Compensation for Damage.—Sec. 18 provides that a licensee shall, in exercise of any of the powers conferred

under this Act, cause as little damage, detriment, and inconvenience as may be, and shall make full compensation for any damage caused by him or by anyone employed by him. Differences under the section are to be referred to arbitration.

The remaining provisions of Part II. of this Act appear to embody many of the important principles laid down in the English Electric Lighting Acts. Sec. 19 gives power to the licensee to enter the premises of a consumer in order to inspect apparatus; Sec. 20 places certain restrictions on the power of the licensee to control or interfere with the use of energy (see Sec. 18 of the Electric Lighting Act, 1882); Secs. 21 and 23 make it obligatory upon the licensee to supply every consumer with energy, and without any undue preference; while Sec. 22 provides for a maximum, which must not be exceeded by the consumer. The supply may be cut off if the consumer omits to pay the lawful charges of the licensee (Sec. 24). The provisions of the Act relating to meters are very similar to those with which we are familiar in this country.

Part 3.—Restrictions on Use of Energy not supplied under Part 2.—Sec. 31 provides that no person shall for any purpose, or in any place in which one hundred or more persons are likely ordinarily to be assembled, or which is a factory within the meaning of the Indian Factories Act, 1881, use energy which is not supplied to him under Part 2, without giving not less than seven clear days' notice in writing of his intention to the District Magistrate, or, in a Presidency town, to the Commissioner of Police, and complying with such rules as may be made in their behalf under Sec. 33. The Local Government may, however, exempt from this order any person using energy on premises upon or in connection with which it is generated.

Rules and Regulations.—By Sec. 33, the Governor-General in Council may for the whole or any part of British India, and each Local Government, with the previous sanction of the Governor-General in Council, may, for the whole or any part of the province, make rules to regulate the generation, supply and use of energy, and generally to carry out the purposes and objects of this Act. The powers here conferred are very similar to those now exercised by the English Board of Trade.

Sec. 39 provides for penalties which may be exacted from those who dishonestly abstract electricity, maliciously cause energy to be wasted or diverted, or otherwise contravene the provisions of the Act.

This Act has the effect of repealing the Electricity Act, 1887, the Calcutta Electric Lighting Act, 1895, and the Howrah Bridge Electric Lighting Act, 1902, but it does not affect the terms of any license which has been granted or of any agreement which has been made by or with the sanction of the Government for the supply or use of electricity before the commencement of the Act.

The schedule to the Act, the terms of which are deemed to be incorporated with every license, follows closely upon the lines of the Schedule to the Electric Lighting (Clauses) Act, 1899, and provides rules for (*a*) Security and accounts; (*b*) Nature and mode of supply; (*c*) Compulsory works; (*d*) Charges; (*e*) Testing and inspection; (*f*) Plans; (*g*) Additional notice of certain works.

VIII. *Jamaica.*—The supply of electricity in Jamaica is controlled by a law which was passed in 1890 *sub. tit.* "The Electric Lighting Law, 1890." This measure seems to be founded on the English Electric Lighting Acts. It provides (by Clause 2) that the Governor in Privy Council may from time to time license any local authority as defined by the law, or any company or person, to supply electricity under this law for any public or private purposes within any area, subject to certain provisions. The "local authority" means the parochial board of the parish within which the license is sought to be obtained. The consent of every local authority having jurisdiction within the area or any part of the area within which the supply is licensed to be furnished is required as a condition precedent to the application for a license. The local authority are authorised to give such consent subject to the approval of the Governor in Council. In addition to the bye-laws which the Governor may make for the purpose of carrying the Act into effect and securing the safety of the public, the local authority may make bye-laws and provide penalties for their breach.

There is a provision for compulsory purchase of an undertaking by a local authority upon terms precisely similar to those of the Electric Lighting Act, 1888.

IX. *Natal.*—There does not seem to be any public Act in force in Natal which authorises or regulates the supply of electricity. In 1902, however, an Act was passed entitled "The Durban County Tramways, Lighting, and Electric Current Supply Act." The greater part of this Act, of course, relates to the establishment of an electric tramway, and is, therefore, somewhat outside the scope of this article, but reference may be made to other provisions which show the trend of legislation in the Colony anent the supply of electricity for light and power.

By Sec. 4 the promoters are "authorised and empowered, subject to such terms as may be imposed by the Government in the contract referred to in Sec. 5 hereof (*vide infra*) to construct, carry on, complete, and maintain the said tramways and to erect standards, posts, supports, or other requisite appliances, whether above or below the surface of the ground, for wires or cables, for transmitting electric current for the purposes of the said tramway, or for the purpose of supplying the same for lighting and other purposes to the owners or occupiers of lands adjacent or near to the said tramway, and to transmit and supply the same for the purposes aforesaid and elsewhere in the County of Durban, according to the powers, rules, orders and directions hereinafter set forth and expressed for that purpose."

By Sec. 5:—"The promoters and the Government of Natal are hereby authorised to contract with each other for the purpose of the promoters acquiring from the Government aforesaid, whether by way of letting, hiring, or granting, and upon such terms as may be mutually agreed upon, the following rights:—

"(*a*) The right of constructing the said tramway aforesaid along the hereinafter mentioned public roads, and the right of working the same.

"(*b*) The right of erecting or constructing and working standards, posts, supports, or other adequate appliances, whether above or below the surface of the ground, for wires or cables on and along the hereinafter mentioned public roads, for the purpose of transmitting or carrying electric current, together with the right of working or transmitting along such wires or cables electric current for lighting or other purposes."

It is provided by Sec. 17 that "subject to the acquisition of powers from the said Government in terms of the Act, the promoters shall have the right to contract with the owners or occupiers of land in the County of Durban for the supplying of electric current, and to charge and demand from any such person or persons so contracting, rates and charges not exceeding those set forth in the schedule to the Act. Provided that the Governor in Council shall have the power from time to time to revise, and, if necessary, reduce such rates and charges."

(To be continued.)

SIMPLE STORIES.

By "INNOCENS."

The Chief Who Would Get On.

There was a Chief of a lighting station whose life was a sore affliction unto him for that he did not get on. And he thought within himself saying, "What now shall I do? For I have attended the meetings of the Institution, yet cannot I find the courage to speak thereat. Likewise have I joined myself unto that other Institution, the Institution of Municipal Engineers, and have revelled at their beanfeasts. Yet lo, nothing seems to come of it, and my spirit is vexed within me."

And as he thought, behold, a light came unto him, and he smote himself upon the knee, and said, "This, now, will I do! I will send a learned article unto the Technical Press, and inscribe upon it my name. Yea, with my full signature will I sign it! Haply, of they which see mine article one having a job in his pocket may read the thing and be impressed."

He went, therefore, within his study and shut his door. Of all the books he had he made an heap, and he scattered the pages of his periodicals as the wind scattered the snow-flakes in the time of winter, to the end that he might find a Subject. Yet lo, of all the Subjects under heaven there was not one which had not aforetime been enlarged upon.

Then was the Chief sore distressed, and wept, saying: "Woe is me, for I am even as other men, and my work as other work, and my station as other stations." But when he had cried for a season his spirit returned unto him, and he said, "This will I do! I will not write a learned article, but I will even write piffle, and verily I will get up a correspondence upon it."

Therefore he wrote an article which was piffle, and got it accepted, for that the Editor was hard up for padding, and all men seeing it said: "What the deuce doth this man suffer from?"

But the Chief went privily unto a friend, the friend of his bosom, and said: "Lo, I have written an article in the Technical Press, and it is rot. Now, therefore, I pray thee, be a friend unto me, and slate that which I have written. Spare me not, for I swear unto thee that I will not proceed against thee for slander. Far better is it to gain an evil and a stinking reputation than none at all."

And his friend said unto him: "Verily, I have seen thine article, and, lo, it is drivel! Yet have I held my peace for that thou art my friend. But since thou entreatest me, lo, I will chastise thee as thy father and thy mother chastised thee in the days of thy youth." And the Chief said: "It is well. Only publish not thy name, but call thyself 'Ajax,' that I may know thee."

When, therefore, the next issue of that journal came forth, all men were amazed. For there was in the "Correspondence" Columns a letter that did scorch the paper for that it was so hot. Yea, the Editor was loath to publish it until he had looked up the law of libel. And when the chief saw it, he chuckled, yet went forth straightway and sought out another friend, and looked exceedingly sorrowful, saying: "Seest thou what this bounder 'Ajax' sayeth of me? If thou be my friend, arise and help me, for the battle goeth against me!"

And the friend looked, and was wrath, and said: "Leave thou this matter unto me! Lo, I will crush him! Lo, I will pulverise him! Lo, I will smite him so that one stone remaineth not upon another!". This said he for that he was excited, and mixed his metaphors. And the Chief said, "Be it so! I leave my case in thy hands. Yet use not thine own name, for the other fellow is anonymous, but sign thyself 'Amicus,' that I may know thee."

And there appeared in the pages of that journal the epistle of Amicus, a part whereof magnified the article of the Chief, and a part defended his character, and a part blackguarded Ajax. And men, beholding it, rejoiced, saying, "Verily, this is a scrap!"

And it was so. For Ajax heated his furnaces seven times hotter, and produced an epistle that was incandescent, to which Amicus replied with coruscations of intense brilliance, so that all men said, "This will end in the Law Courts!" And they looked up the back numbers of the journal for the article of the Chief, to see what the row was about; and because they could not understand it, they imagined the article to be clever. And the fame of the Chief waxed exceeding great.

But it came to pass that Amicus took a journey, even unto the West-end, and sate himself in an hostelry, the hostelry which is called the Café d'Asia. And as he sat, behold, he saw a friend of his drinking strange drinks, and he said unto him, "What dost thou here?" And the man answered him, "Verily, I am looking after a young *protégé* who is unused to this sort of thing, that he fall not into temptation. But what dost thou here?" And Amicus said, "Verily, I am also befriending a young man." And his friend said, "Where is this youth?" And Amicus said, "And where is thy friend?" And they looked at each other and laughed.

And Amicus said, "Lo, I am in trouble, for I wrote in the Technical Press a letter defending a friend of mine from the wanton attack of a villain named Ajax, and I am like to appear in the Law Courts."

And his friend was astonished thereat, and said, "Art thou Amicus? Come and refresh thyself." And when they had refreshed, he spake again, saying, "Lo, I am Ajax! For that friend of whom thou speakest asked me to attack him. Now, therefore, I will instruct my lawyer that he stay proceedings. And Amicus took him by the hand, saying, "And what now shall we do to our friend?"

And, lo! At that moment the Chief also entered, but when he saw his friends clasping the hand of one another the fashion of his face changed, and he sought to depart. But his friends caught hold of his garment, saying, "Tarry a little, for we have somewhat to say unto thee!"

And the last state of that man was worse than the first.

CHIMNEY ACTION.

By W. H. BOOTH.

Formulæ for chimneys frequently offer evidence that the framer of the formula, or the man who tore it from its context and nailed it down in the pages of a pocket-book, did not realise facts. Such items as horse-power or nominal horse-power of a chimney, or as an item in a chimney formula, are very much out of place. To speak of the horse-power of a chimney, is, to put it mildly, somewhat ambiguous. Does it refer to the power of the engine driven by steam from the boilers served by the chimney? We believe it is so intended. But it might refer to the actual power developed by the chimney as a heat engine, for such a chimney really is. It is an engine which serves to lift from fifteen to fifty times the weight of fuel burned to a height measured between the grate surface and the chimney top, and the motive power is heat. To render the matter clear, a given case may be assumed of a chimney carrying off 20 lbs. of flue gas for each lb. of coal burned. The calorific capacity of the coal will be assumed at 14,220 B.T.U. The chimney temperature is, let it be assumed, 360°, or, say, 300° above the external temperature. The specific heat of flue gases may be approximated very closely at 0·237. Then the heat units escaping at the chimney are $20 \times 300 \times \cdot237 = 1{,}422$ B.T.U. This is just one-tenth of the heat value of the coal. An ordinary boiler, with 40 sq. ft. of grate, and burning 20 lb. of coal per sq. ft. of grate area per hour, thus turns into the chimney 1,137,600 heat units per hour, representing, if it could all be turned into work, 448 H.P., or about 30 H.P. if used by a fair engine. But the horse-power of a first-rate engine using the steam generated by the boiler would be fully 400 to 600 on a steady load, and, if equally well applied, the chimney heat would represent the tenth of this, or 40 to 60 H.P.

Now, what is really done by the chimney? Let it be assumed to be 250 ft. high. The hourly escape of gas is 16,000 lbs., and the foot-lbs. of duty 66,666 per minute, or, say, 2 H.P. The efficiency of this particular chimney would thus appear to be very low, only 0·05 to 0·075. The final energy of movement in the escaping gases will add perhaps 5 per cent. to the foot-lbs. of work done. It is rare, indeed, that chimney temperatures so low as 360° are encountered, and the weight of gases is often much over 20 lbs. per lb. of fuel.

It hardly seems advisable to proportion chimneys from a basis of horse-power, for there is no fixed rate of coal consumption per horse-power of the engines. Neglecting altogether the engines, and taking boilers as specified, the chimney should be proportioned to suit the gases flowing through it, and the volume of these depends upon the grate area and the rate of combustion. Taking the example already chosen to deal with 16,000 lb. of gas per hour at, we will now say, 400°, what is the volume to be dealt with? At 32° the volume will be about 13 cb. ft. per lb., and at 400° it will be nearly 24 cb. ft. per lb. The volume per second will be 105 cb. ft. At a velocity of 30 ft. per second, an area of $3\frac{1}{2}$ sq. ft. would be sufficient. There is a good deal of misapprehension as to the action of a chimney, and still more as to its treatment. It is of little use to build a chimney suitably proportioned for the duty it will be called on to perform, and then to reduce its efficiency by leakage in the manner too often allowed.

The common idea that a chimney acts by suction is entirely erroneous. A pump may be said to act by suction in that the movement of its piston leaves a vacuum into which the external pressure of the atmosphere tends to flow, or to cause to flow, another interpolated fluid. In this sense of acting by suction, it is perfectly allowable to describe the action of a pump, but not that of a chimney. If the entrance to the base of a chimney be closed, there is stopped at once all upward movement of the contents within, no matter to what high temperature the contained gases may have been raised. But close the entrance to a pump, and continue to move the piston, and an empty space is formed, or a space the contents of which are at less than atmospheric pressure.

To gain a clear idea of the working of a chimney, we will suppose that a cold chimney be taken, and its inlet closed at the base. Then, upon heating the chimney, its contents will become heated, and will expand, the surplus bulk of air pouring over at the top. Let us suppose that the rise in temperature has been 100° C. above an external temperature of 0° C. Then the increase in bulk will be $\frac{1}{2}\frac{0}{7}\frac{0}{3}$, or, in a chimney 273 ft. high, the expansion of the air would have protruded a column 100 ft. long.

In other words, the atmosphere has been displaced 100 ft., showing 1,500 ft.-lb. of work per inch of area, and when full of hot air, the weight remaining is only $\frac{1}{2}\frac{7}{7}\frac{3}{3}$ of its original weight. In other words, the heating of the chimney has reduced the pressure at the chimney base by the weight of the extruded 100-ft. column. A barometer inside would show a less pressure than one outside, and an opening cut through the base would show this by the inrush of the outer air.

In boiler working, the object should be to allow no entrance to the chimney except *via* the fuel-covered grate, or other intentionally made openings. But actually there are numerous other openings, chief among which we may cite sliding dampers in ill-fitting frames. These afford a collective area of large amount for leakage of air, as may be shown by producing a quantity of smoke in the neighbourhood of the damper, and noting the manner in which it flows into the damper slot. It is not drawn in ; it flows in by virtue of its pressure being greater than that in the flues.

Frame dampers are, therefore, objectionable, the swivel damper, of which simply the small central spindle alone comes through to the outer air, is to be preferred. Though not so plainly apparent, faults in the brickwork seatings and walls of a boiler admit quantities of cold air, to the serious detriment of the draught, and all brickwork should not only be well painted, but the whole surface ought to be air proofed by some continuous sheet of glaze, either pitch or paint, for, in heat-dried brickwork, the porosity of a large surface is very considerable. All these facts make the professorial analyses of chimney gases appear ridiculous.

Without a word as to the condition of the brickwork, we may read reports showing the percentage composition of air contained in the smoke drawn by carefully-devised means from the chimney. Such analyses form a basis from which to argue upon the quantity of air required or used in excess of that chemically necessary for combustion, and are, of course, quite misleading.

A battery of boilers being so much less exposed to air leakage into the flues than a single boiler, will usually give better results. It is said that a funnel covering a 4-ft. circle on a brick wall facing the wind, in ordinary weather, will blow a candle out at its apex, and this action is intensified on a heat-dried wall. Now, looking upon a chimney simply as a receptacle for such air as can pass in from without, it is plain that draught is merely the inrush of outer air to which a kind of perpetual energy is given by the heat of the fire placed in the passage way. As the fire is extinguished the draught gradually diminishes with the cooling of the chimney lining. Continuity of action depends upon temperature difference, and a disused chimney will act upwards or downwards with changes of the atmospheric temperature, especially when a sudden change follows a prolonged period of higher or lower temperature.

If a U water gauge be connected to the chimney base and flues at intervals all the way to the furnace door, a gradual diminution of pressure will be noticed. The greatest difference of pressure will be at the base of the chimney. This is the motive pressure that produces the draught. This acting agent is consumed in two ways. It lifts the products of combustion to the chimney top, and overcomes the friction of the flowing air against the flue walls and between water tubes. The whole of the pressure difference that is found at the furnace mouth is converted into energy of motion and becomes the draught. The chimney base gauge reading may be considerable, and where the flues are narrow, rough, and obstructed, there may be a very low reading at the furnace; the draught will be poor. All bends and cross pipes and roughnesses act as so many supports to resist the tumbling of air into the furnace.

So far as draught is concerned, we need apparently only concern ourselves with the pressure at the bridge, but it is important that the flue friction should be small in order that the fullest possible proportion of the chimney effect should be secured. In a properly constructed and worked furnace no greater volume of hot gases can ever flow along the flues than that proper to the weight of fuel required to be burned. Thus there can be no objection to making flues roomy, and as direct and free from obstruction as possible.

Under the old and still common notion that a chimney acted by suction, the idea prevailed that if the flues were straight and unobstructed, the chimney would draw out all their hot contents, and reduce the efficiency of the boiler. This idea was based on what was equivalent to a belief that a partial vacuum could exist in the flues, and they were made narrow and tortuous to prevent the above *prejudicial* action of the chimney, in ignorance that nothing could leave the flues and enter the chimney unless *pushed* from behind by the gases in the furnace, which were only produced in a volume proportionate to the weight of fuel burned, and it is now known that the best way of regulating the weight of fuel to be consumed is by dampers that will vary the opening to the ashpit, *i.e.*, to the underside of the grate, not by contracting the flue outlet to the chimney as in the usual practice. Flue dampers are merely useful when one of a battery of boilers is laid off to shut off the chimney when the flues are open for cleaning and inspection. The ashpit damper has special advantages in regard to the smokeless combustion of bituminous coals, in that by its use the flow of air through a door grid, louvre, or register, can be fully maintained after a firing charge, as the ashpit dampers may be closed and smoke prevented, whereas a fresh charge of fuel upon a furnace with the ordinary flue dampers will produce an immense volume of smoke simply because no fresh air can enter by the furnace door registers.

It will now be apparent that draught is dependent on several factors, viz., chimney height to give a sufficient height of enclosed column of heated gases so as to diminish the chimney base pressure. Chimney area to permit of the flow of the furnace products at a reasonable velocity—a too high velocity — producing too much friction :—Temperature inside the chimney sufficiently greater than atmospheric temperature, so that there may be sufficient difference of pressure at the base of the chimney inside and out.

This factor clearly has the same effect as chimney height, and may be made to replace it, a higher temperature doing duty for a higher chimney, and permitting of a shorter chimney, flue length and area, since both these have a bearing upon the frictional resistance to the flow of the gases.

The height of the furnace bridge is a part of this factor. Too often we may find a bridge built close up to a boiler or flue crown to "keep the heat up to a boiler." These high bridges are simply obstructions, and, as a general rule, it may be laid down that a bridge need be no higher than the maximum thickness of the fire, as many a fireman has found out by accidentally pushing over a decayed bridge wall with the rake, to the great benefit of efficiency.

Probably, not one in a hundred engineers has paid much attention to the velocity with which the gases flow through the flues or chimney, and it is instructive to take an ordinary rule for chimney proportion, and an accepted practice as to fuel consumption, and learn from these factors something of the conditions of flow in the chimney. When height is to be saved by the employment of a greater temperature, regard must be had to the need for greater area of chimney in, approximately, the ratio of the absolute temperatures of the waste gases.

As chimneys are expensive luxuries, it is important that they should not be overloaded by being called on to carry more air than absolutely necessary. Excess of air is carried in at uncovered bars and at bad brickwork, and the latter fault is very apparent where analyses are made of the flue gases from behind the bridge, behind the boiler, and at the chimney base. The weight of air used per lb. of coal may be as low as 15 lbs., and in bad cases it may be as high as 50 lbs. In ordinary practice there is usually a wide margin for improvement on this score.

Excessive air not only reduces the temperature in the fire, but of the chimney base. The chimney is thus overloaded both in weight and bulk, with, perhaps, less acting power.

An ordinary 8-ft. Lancashire boiler, with 40 ft. of grate surface, has furnace tubes of 40 in. diameter, the area of which is about 17½ sq. ft. The area over the bridges is probably not over 6 or 7 sq. ft., or from a seventh to a sixth of the grate area. The flue tubes are of nearly half the grate area, and the small area over the bridge, being of short length, does not add much to the resistance up to a certain velocity.

The bottom flue will ordinarily have an area of about 10 sq. ft. The two side flues have damper openings of about 10 ft. The area of the chimney would be about 3½ sq. ft. by one rule, and this would agree with the assumed velocity above of 30 ft. per second. In actual modern practice this area is probably more often exceeded than not. Thus a Stockport cotton mill working three 8-ft. boilers has a 210-ft. chimney 8 ft. diameter, or over 16 sq. ft. per working boiler. Another Lancashire mill, which works five 8-ft. boilers, has a chimney of 180 ft. which is only 7 ft. diameter, giving an area of only 7·7 sq. ft. per boiler.

In each case there is an economiser of over 400 pipes. A third textile factory working three boilers also 8 ft. diameter, has a 5½ ft. diameter chimney only 150 ft. high, with an area of nearly 8 ft. per boiler. Here there is a 272-pipe economiser.

It appears that the calculation in the early part of this article of 3½ sq. ft. for ideal conditions finds itself doubled at least in practice to allow for excess of air and heavier coal consumption. But the 16 sq. ft. is excess, and implies waste of capital, though it is urged by some engineers that so far from diminishing in area in proportion as the gases diminish in bulk as they cool, both flues and chimney should increase in area towards the chimney top.

The acting power of a chimney varies as the sq. root of its height. Increased height, therefore, tells rapidly in small chimneys of 50 to 100 ft., but when heights of 200 ft. are attained, an increase to even 300 ft. only adds 22 per cent. to the chimney power, while it adds considerably to its necessary external diameter, and does not allow the reduced diameter that increase of height otherwise permits. Similarly as the action of temperature in promoting draught is a function of the absolute, not of the thermometric temperature, the effect of temperature must not be over-rated. Very little benefit indeed is gained by chimney temperatures over 300° or 350° F. True, the draught velocity is considerably increased, but the weight of gases delivered is hardly increased at all with higher temperature, and actually falls off again above about 600° F. A height of 200 ft. seems to have been accepted as necessary in the textile districts, where economisers are practically universal, and this height should be assumed when comparing natural or chimney and forced or fan draughts. As in all matters of engineering, a chimney is a compromise of height, area and temperature conditions, with the uncertainties of fuel combustion and future plant additions to modify its present apparently best design. Hence the value of fan draughts in electric power stations which may, or may not, grow in size, and can at any time be given the necessary draught plant.

Southend and Colchester Light Railways Order.—The Board of Trade has recently confirmed the Southend and Colchester Light Railways Order, 1904, authorising the construction of light railways in the county of Essex from Southend by way of Rochford, Creeksea, Burnham, Southminster, Asheldham, Dengie, Tillingham, Bradwell-juxta-Mare and West Mersea to Colchester.

THE DESIGN OF INDUCTION MOTORS.

By A. PRESS.

In designing induction motors one has rather to modify the method indicated in the writer's article on "Design of Dynamos."* In induction motors the matter of a good cos ϕ is so all-important that the element of permissible heating plays rather a secondary *rôle*. Nevertheless, the output formula or "design equation" can be fairly well reduced to the following :—

$$\frac{\text{Output in KW.}}{\eta} = \text{KW. input}$$
$$= (\cdot 75 \text{ to } 1\cdot 25)\ 10^{-6} \cdot D^2\, l \cdot \text{revs. (cm)}^3. \quad (1)$$

The ratio of $\frac{D}{l}$, as in the above-mentioned article, can be determined in terms of p, but, in this instance, it is not the condition for minimum copper loss that suggests the proper factor for p, but rather the value for σ, or the ratio of no-load current to the stand-still rotor current.

If one will adopt the suggestions of Mr. Hobart anent the equation for σ, one can express the modified Behrend formula as follows :—

$$\sigma = \frac{1\cdot 28}{\tau}\left\{17\cdot 3 - 3\cdot 7\, x - (3 + 2\, x)\frac{l}{\tau}\right\}\sqrt{\frac{\delta}{N}}. \quad (2)$$

Here x = ratio of slot opening in overhang to slot width.
l = length of core (gross).
τ = pole pitch.
δ = air-gap.
N = average number of slots in stator and rotor, per pole pitch.

The dimensions are in centimetres. Let R^1 = revs. per second, and c = frequency. Then

$$\tau = \frac{\pi\, D\, R^1}{2\, c} = \frac{\pi\, D}{p},$$

and (2) becomes

$$\sigma = \frac{2\cdot 56}{\pi\, D} \cdot \frac{c}{R^1}\left\{17\cdot 3 - 3\cdot 7\, x - \frac{2}{\pi}(3 + 2\, x)\frac{l}{D}\cdot\frac{c}{R}\right\}\sqrt{\frac{\delta}{N}},$$

which is of the form

$$\sigma = \frac{a}{D}\left\{b - \frac{c\, K}{D^3}\right\},$$

where $K = D^2 l$.

For $\frac{d\sigma}{d\, D} = 0$,

$$\frac{D}{l} = \frac{4}{\pi}\left(\frac{3 + 2\, x}{17\cdot 3 - 3\cdot 7\, x}\right) \cdot p. \quad (3)$$

If $x = 0$ (which is the condition for closed slots),

$$\frac{D}{l} = \cdot 221\, p, \quad (4)$$

and for $x = 1$, or, for wide open slots,

$$\frac{D}{l} = \cdot 468\, p. \quad (5)$$

The equation (3) can be thrown into the form

$$\frac{l}{\tau} = \frac{17\cdot 3 - 3\cdot 7\, x}{4\,(3 + 2\, x)}, \quad (6)$$

and, for limits,

$$\frac{l}{\tau} = \cdot 68 \text{ to } 1\cdot 45. \quad (7)$$

If the value of $\frac{l}{\tau}$ in equation (6) is substituted in equation (2), the best value of σ will be given as

$$\sigma = \frac{(10\cdot 6 - 2\cdot 26\, x)}{D} \cdot \frac{c}{R} \cdot \sqrt{\frac{c}{N}}, \quad (8)$$

and this at once shows that the value of σ for open and closed slots is no more than 1 : 1·26. It is to be noted that this is only obtained at the expense of $\frac{l}{\tau}$ diminishing from 1·45 to ·68 as shown above, or, diminishing the value of l

* See Electrical Review, September 16th, 1904.

to about one-half. This naturally means increased expense as can soon be tested by one of the forms of the price equation.* Having obtained a satisfactory ratio for $\frac{D}{l}$ in terms of p (the revs. and output are usually given), the price can be investigated, and the gross dimensions soon settled upon.

It has been shown in the case "Design of Dynamos" that

$$\text{KW.} = \frac{a^1 \, D^2 \, l \, . \, \text{revs.}}{f(100 - \eta)}, \text{ or } \eta = 100 - \frac{a^1}{f} \cdot \frac{D^2 \, l \, . \, \text{revs.}}{\text{KW.}}.$$

Assuming f a constant, and adopting the following empirical output equation for direct current,

$$D^2 \, l \text{ revs.} = 36 \times 10^5 \, (1{\cdot}5 + \sqrt{\text{KW.}})^2$$

(this latter equation holds good for 1—1,000 KW.), the value of η becomes

$$\eta_{\text{D.C.}} = 100 - 4{\cdot}5 \left(\frac{3{\cdot}5}{\sqrt{\text{KW.}}} + 1 \right)^2.$$

Adopting the same method, one obtains for induction motors

$$\eta_{\text{I.M.}} = 100 - 8 \left(\frac{0{\cdot}8}{\sqrt{\text{KW.}}} + 1 \right)^8,$$

and thus, by means of equation (1) the value of $D^2 \, l$ can be evaluated.

It behoves us next to investigate the dimensions of slots, and the conditions for a minimum magnetising current. This latter problem is analogous to settling upon an "excitation equation," as was done for the case of the dynamo. This process is, however, complicated by the fact that here one has two sets of slots, and two tooth pitch ratios to contend with—

Let r_s = tooth pitch ratio in stator.
r_r = tooth pitch ratio in rotor.
$\frac{B_s}{H_s}$ = real value of μ in stator.
$\frac{B_r}{H_r}$ = real value of μ in rotor.

and as before

$$\lambda = \frac{\pi \, D \, \rho \, (1 - r)}{n}.$$

The excitation loss may then be represented by the following, expressed as a function of r, B, and H.

$$a \, H_s \, (1 - r_s) + b \, \{B_s r_s + H_s (1 - r_s)\} + d \, H_r (1 - r_r) \quad (9)$$

with the condition that—

$$B_s r_s + H_s (1 - r_s) = B_r \, H_r + H_r \, (1 - r_r). \quad (10)$$

This latter furnishes a value for r_r,

$$r_r = \frac{B_s r_s + H_s (1 - r_s) - H_r}{B_r - H_r}, \quad (11)$$

and (9) becomes—

$$a \, H_s \, (1 - r_s) + b \, \{B_s r_s + H_s \, (1 - r_s)\} + d \, H_r - \frac{d \, H_r}{B_r - H_r} \, \{r_s (B_s - H_s) + H_s - H_r\}. \quad (12)$$

Taking $\frac{d}{d \, r_s} = 0$, equation (12) gives $\frac{B_s}{H_s} = \frac{a}{b} + 1 + \frac{d}{b} \cdot \frac{B_s - H_s}{H_s} \cdot \frac{H_r}{B_r - H_r}$. (13)

Neglecting the value of H with respect to B—thus virtually precluding the case of exceptionally high densities—

$$\frac{B_s}{H_s} = \frac{a}{b} + 1 + \frac{d}{b} \, \frac{B_s}{H_s} \cdot \frac{H_r}{B_r}, \quad (14)$$

and on account of symmetry, the value of $\frac{d}{d \, r_r} = 0$ can easily be seen to lead to

$$\frac{B_r}{H_r} = \frac{d}{b} + 1 + \frac{a}{b} \, \frac{B_r}{H} \cdot \frac{H_s}{B_s}. \quad (15)$$

Solving the equations (14) and (15) for $\frac{B_r}{H_r}$, the following is arrived at—

$$\frac{B_r}{H_r} = \frac{a}{b} + \frac{d}{b} + 1, \quad (16)$$

and, by symmetry,

$$\frac{B_s}{H_s} = \frac{d}{b} + \frac{a}{b} + 1. \quad (17)$$

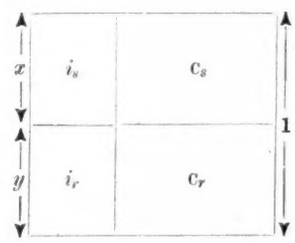
Thus the best arrangement of slots, as regards the value of r, is when $r_s = r_r$ and $\frac{B_s}{H_s} = \frac{B_r}{H_r} = \frac{B}{H}$.

The value of $\frac{B}{H}$ is given by equations (16) or (17), and, by referring to the paper on "Dynamo Design" already cited, it is easily seen that—

$$\frac{B}{H} = \frac{\frac{\pi \, D}{n_s}}{K_{1s} \, \delta} \rho_s + \frac{\frac{\pi \, D}{n_r}}{K_{1r} \, \delta} \rho_r + 1. \quad (18)$$

The geometrical representation of $\frac{B}{H}$ follows analogously and obviously.

There is still the investigation of the ratio of stator depth of slot to rotor depth of slot.



Let the figure represent one tooth pitch for stator and rotor with the horizontal dividing line to denote the position of the air gap. Also let—

i_s = stator iron in one tooth pitch.
i_r = rotor iron in one tooth pitch.
C_s = stator copper in one tooth pitch.
C_r = rotor copper in one tooth pitch.

Also let—

$$x = m \, y \text{ and } x + y = 1.$$

Then—

$$x = \frac{m}{m + 1} \text{ and } y = \frac{1}{m + 1}.$$

The losses can then be set forth as follows—

$$i_s \cdot \frac{m}{m + 1} = \text{stator iron loss in teeth,}$$

$$i_r \cdot \frac{1}{m + 1} = \text{rotor iron loss in teeth,}$$

$$C_s \cdot \frac{m + 1}{m} = \text{stator copper loss in slots.}$$

$$C_r \cdot (m + 1) = \text{rotor copper loss in slots.}$$

The condition to be fulfilled is by the former treatment

$$i_s \cdot \frac{m}{m + 1} + i_r \cdot \frac{1}{m + 1} = \left\{ C_s \cdot \frac{m + 1}{m} + C_r \, (m + 1) \right\}. \quad (19)$$

The value of χ would still be 2. Assuming that r has been calculated for the case where the stator losses = rotor losses, and rotor frequency = stator frequency, then—

$$i_s = i_r \, ; \; C_s = C_r \text{ and } m = 1.$$

Hence by (19)

$$\chi = \frac{i_s}{4 \, C_s}.$$

Taking into account that the rotor frequency is very much less than the stator frequency, the value of i_r may be represented by $\frac{i_s}{p}$. In this case in order that the losses in the iron relative to the copper may conform as nearly as possible to the old condition, it is obvious that with a given r the

* See former article on dynamo design, and also a communication to the *Electrician* of August 12th, 1904.

air-gap horizontal dividing line will have to be shifted. Thus when $x = m\,y$, the ratio of losses becomes—

$$\frac{i_s \cdot \frac{m}{m+1} + i_s \cdot \frac{1}{v(m+1)}}{c_s \cdot \frac{m+1}{m} + c_s \cdot (m+1)} = \frac{i_s}{c_s} \cdot \frac{m\left(m + \frac{1}{v}\right)}{(m+1)} \quad (20)$$

and by inspection it is easily seen that

$$\frac{m\left(m + \frac{1}{v}\right)}{(m+1)^3} \text{ should equal } \tfrac{1}{4}. \quad (21)$$

The maximum value of m is given by $\frac{d}{d\,m} = 0$, but it may first be worth while noting that since the iron loss is proportional to about the 1·4th power of the frequency, the value of $\frac{1}{v}$ relative to unity is negligible. The slip is always in the neighbourhood of 5 per cent., and thus

$$\frac{1}{v} = \frac{\left(\frac{5}{100}\ c\right)^{1\cdot4}}{c^{1\cdot4}} = \cdot015.$$

The expression (21) investigated for $\frac{d}{d\,m} = 0$ gives

$$m = 2. \quad (22)$$

Thus the stator slots should have twice the depth of the rotor slots. It is as well to give an empirical formula for the *combined* depth of stator and rotor slots. It is

$$\lambda = 4 \log_{10} \text{D (cm.)}. \quad (23)$$

A METHOD OF MEASURING THE OUTPUT OF INDUCTION MOTORS.

In the *Electrical World and Engineer* for August 6th, 1904, Mr. E. Alexanderson gives a new method of measuring the output of induction motors, which is used for commercial testing by the General Electric Co., of America.

The method is based upon the very accurate way of measuring the slip stroboscopically.

A tin disk painted in black and white sectors is screwed to the end of the shaft. The number of sectors is equal to the number of poles of the motor. On holding an arc lamp fed from the same source as the motor near the latter while it is running, the sectors appear to revolve with the speed of the slip. This speed varies from 10 to 60 revs. per min., according to the size of the motor. Remembering that 45° = one-eighth of a revolution, it is seen that the slip can be observed even to one-sixteenth of a revolution at lower speeds.

Within the limit of full load the slip is almost exactly proportional to the torque delivered by the rotor. If the motor is loaded by a direct current machine, its output is partially consumed by the output of the generator, as measured by direct current instruments, and partly by the losses in the generator and belt.

The output of the rotor is, therefore, divided up as follows:—

1. Bearing loss of rotor.
2. Belt loss.
3. Bearing loss of generator.
4. Core loss of generator.
5. C^2R loss of generator.
6. Output of generator.

If the load of the generator is thrown off, but the excitation (taken from another source) kept constant, the motor will carry the following load:

1. Bearing loss of rotor.
2. Belt loss.
3. Bearing loss of generator.
4. Core loss of generator.

The torques corresponding to the losses 1, 2, 3 and 4, are the same in both cases, although the losses themselves vary slightly when the motor changes speed. If one slip reading is taken in the first and one in the second case, these readings will be proportional to the torques, and the difference between the slip readings proportional to the difference between the torques.

Let us denote the various quantities as follows:

	Full load.	D.C. load off.
Slip	S	S_1
Total torque of rotor	T	T_1
Total output of rotor	P	P_1
Volts × amperes of generator	V A	

We then have, since the torques are proportional to the outputs at full-load speed,

$$\frac{P}{P - P_1} = \frac{T}{T - T_1} = \frac{S}{S - S_1}.$$

But $$P - P_1 = V A + C^2 R,$$

therefore $$P = \frac{S}{S - S_1}(V A + C^2 R).$$

This power is the output of the rotor, and includes the losses by bearing friction and windage, P_0. The counter torque of these losses corresponds to the slip at light load, S_0.

We have $$\frac{P_0}{P - P_1} = \frac{T_0}{T - T_1} = \frac{S_0}{S - S_1},$$

therefore $$P_0 = \frac{S_0}{S - S_1}(V A + C^2 R).$$

The useful output of the motor is

$$P - P_0 = \frac{S - S_0}{S - S_1}(V A + C^2 R).$$

The constant losses of the generator with belt are

$$P_1 - P_0 = \frac{S_1 - S_0}{S - S_1}(V A + C^2 R).$$

The quantity C^2R is so small that it can either be neglected or estimated from the size of the direct-current machine.

When the constant losses of the generator with belt have once been ascertained, the output of the motor at any load can be determined by adding these losses to the direct current output.

A number of experiments have been made in order to test the reliability of the new method of measuring the output, and it appears that the results agree very closely with those obtained by the method which involves a separate test of the efficiency of the generator with belt. The table given below shows what can be expected of the method, in average commercial tests.

OUTPUT OF MOTOR.

By separate test of D.C. machine.	By slip.	By separate test of D.C. machine.	By slip.
14·5 ...	14·05	14·1 ...	13·75
21·0 ...	21·3	10·15 ...	10·4
5·1 ...	5·3	10·6 ...	10·6
10·7 ...	10·45	150·0 ...	145·5
10·9 ...	10·35	40·3 ...	40·5
99·3 ...	99·0	14·1 ...	13·75
10·9 ...	10·3	10·15 ...	10·5
99·2 ...	97·5	10·6 ...	10·6
49·4 ...	46·0	9·82 ...	10·4
150·0 ...	144·5	10·3 ...	10·1
40·3 ...	40·5	26·1 ...	26·6

As an example the following actual case is given:—

Full load slip = $52\frac{1}{2}$.

Volts × amperes of generator = 128 × 22·6 = 2,890 watts.

Direct-current load off: slip = $11\frac{7}{8}$.

Running light: slip $S_0 = 2\frac{1}{8}$.

The machine used for load being a 15-H.P., 125-volt machine, its armature resistance can be estimated = 0·03 ohm, and the C^2R loss = 0·03 × 22·6² = 15 watts.

A mistake in this estimate would be of no importance when the C^2R loss (15 watts) was added to the output, 2,890 watts.

Full load of motor:—

$$P - P_0 = \frac{S - S_0}{S - S_1}(V A + C^2 R),$$

$$= \frac{52\frac{1}{2} - 2\frac{1}{8}}{52\frac{1}{2} - 11\frac{7}{8}}(2{,}890 + 15),$$

$$= 3{,}605 \text{ watts},$$

$$= 4{\cdot}81 \text{ H P}.$$

Constant losses of generator with belt :—

$$P_1 - P_0 = \frac{S_1 - S_0}{S - S_1} (V A + C^2 R),$$

$$= \frac{11\frac{7}{8} - 2\frac{1}{8}}{52\frac{1}{2} - 11\frac{7}{8}} \times 2{,}905,$$

$$= 700 \text{ watts.}$$

Bearing friction and windage of motor :—

$$P_0 = \frac{S_0}{S - S_1} (V A + C^2 R),$$

$$= \frac{2\frac{1}{8}}{52\frac{1}{2} - 11\frac{7}{8}} \times 2{,}905,$$

$$= 15 \text{ watts.}$$

When the output per revolution of the slip has once been ascertained, it is possible at any time when the motor is in practical operation to measure the output by means of the slip reading. All that is needed is to draw on the shaft end with a piece of chalk as many sectors as the motor has poles. If the light of an arc lamp fed from the same source as the motor is thrown on the shaft end, the sectors will appear to revolve with the speed of the slip.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

20,653. "Invention for deadening live rail used for electric railway traction purposes, and also indicating when the said rail is alive." R. W. Scott. September 26th.

20,656. "Continuous electric furnace for reducing metallic oxides or other compounds." P. Auchinachie. September 26th.

20,667. "Improvements in intercommunication switchboard for telephone and other electric instruments." J. A. Romer. September 26th.

20,670. "Improvements in a communicating switch and circuits for controlling electric carriages and like purposes." H. F. Joel. September 26th.

20,689. "Improvements relating to the regulation or control of dynamo-electric machines and electric motors." C. P. E. Schneider. September 26th. (Complete.)

20,713. "Improvements relating to electric transformers." The British Thomson-Houston Co., Ltd. (The General Electric Co., U.S.) September 26th.

20,715. "Improvements in insulations for edgewise wound coils." The British Thomson-Houston Co., Ltd. (The General Electric Co., U.S.) September 26th.

20,725. "Safety contact trippit for electric trains." W. Coates and G. Wright. September 27th.

20,749. "Improvements in trolley boom controlling apparatus for electric tramcars and the like vehicles." S. Hindley. September 27th.

20,759. "Improvements in and relating to mechanism for electrically-operated pianos and other musical instruments." A. J. Clarke. September 27th.

20,782. "Improvements in the electrolytic extraction of zinc from its ores and apparatus therefor." A. G. Bloxam. (Société Anonyme d'Etudes Electro-Chimiques, Switzerland.) September 27th.

20,788. "Improvements in electrical telegraphs and controlling apparatus." A. V. Vyvyan and L. Newitt. September 27th.

20,788. "Improvements in the winding for monophase or polyphase alternating current electric machines." Elektrizitats Act-Ges. vormals W. Lahmeyer & Co. (Date applied for under Patents Act, 1901; November 12th, 1903, being date of application in Germany.) September 27th. (Complete.)

20,804. "Improvements in and connected with wireless telegraphy systems." W. P. Thompson. (Gesellschaft fur drahtlose Telegraphie m.b.H., Germany.) September 27th. (Complete.)

20,809. "Improvements in electric furnaces." The British Thomson-Houston Co., Ltd. (The General Electric Co., U.S.) September 27th.

20,810. "Improvements in electric furnaces." The British Thomson-Houston Co., Ltd. (The General Electric Co., U.S.) September 27th.

20,898. "Improvements in or relating to the manufacture of water-jackets, casings, and the like by electrolytic means." A. F. Bosquet. September 28th. (Complete.)

20,898. "Improvements in or additions to pipes or tubes for containing underground electrical cables or conductors." E. J. Chambers. September 28th.

20,931. "Improvements in the manufacture of switchboards for electrical purposes." F. C. Ruddle. September 29th.

20,953. "Improved electric igniter for simultaneously igniting and simultaneously or successively extinguishing gas burners." O. Candi and C. Candi. September 29th. (Complete.)

20,965. "Improvements in and relating to the leading-in conductors for electric incandescent lamps and the like." E. A. Carolan. (The General Electric Co., U.S.) September 29th.

20,968. "Improvements in or relating to central station electric installations." J. S. Highfield. September 29th.

20,970. "Improved braking device for electric motors." A. Hultquist. September 29th.

20,997. "Improved means for controlling the flow of electricity into third or operative rails, or similar appliances for vehicular or other traffic, the said means being also available for signalling purposes." J. Graham and R. Kendal. September 30th.

21,007. "Improvements in apparatus for controlling the supply of electricity." A. Schneider. September 30th.

21,028. "Improvements in electrical measuring instruments." G. K. B. Elphinstone and H. F. Fast. September 30th.

21,039. "An improved electric bell-push." J. H. Hilliar. September 30th.

21,040. "Improvements in or connected with electric arc lamps." F. W. E. Schuer. September 30th.

21,042. "Improvements in and relating to electric arc lamps." E. R. Grote and M. V. Ely. September 30th.

21,043. "Improvements in alternating current electric motors" E. A. Carolan. (The General Electric Co., United States) September 30th.

21,045. "Improvements in single-phase dynamo-electric machines." E. A. Carolan. (The General Electric Co., United States.) September 30th.

21,131. "Improvements in automatic electric switching devices applicable to flash advertising signs and the like." P. B. H. Seabrook and H. H. P. Seabrook. October 1st.

21,132. "Improvements in and in the arrangement of switch gear for electrical driving." W. P. Thompson. (L. Dill, Germany.) October 1st.

21,135. "Improvements in or relating to fuses for electric circuits." A. R. Pritchard and R. Whipp. October 1st.

21,138. "New or improved electro-magnetic therapeutic apparatus." E. Bachelet. October 1st. (Date applied for under Patents Act, 1901, October 2nd, 1903, being date of application in United States.) (Complete.)

21,144. "Improvements in the electric lighting of trains." H. Leitner and R. N. Lucas. October 1st.

21,145. "Improvments in means for automatically controlling electric circuits." H. Leitner. October 1st.

21,146. "Improvements in accumulator plates." H. Leitner. October 1st.

20,791. "A device for supporting electrical conductors." C. F. Bettmann and J. Zapp. September 27th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

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Electrical Arc Lamps. Guest, Keen & Nettlefolds, Ltd., and W. E. Symons. 15,746. July 16th.

Dynamo-Electric Machines for Regulating the Charge and Discharge of Storage Batteries used in Conjunction with Main Generators. The Lancashire Dynamo and Motor Co., Ltd., and R. S. McLeod. 15,811 July 17th.

Electrically-Actuated Musical Instruments. W. Kennedy-Laurie Dickson. 15,817. July 17th.

Welding Railway Rail Joints by Electricity. H. F. A. Kleinschmidt. 15,831. July 17th.

Fusible Electric Cut-Outs. K. W. Hedges. 15,838. July 17th.

Electric Tram Cars. J. W. Lycett and G. T. Conatt. 15,970. July 20th.

Means for Breaking Electric Circuits. C. B. Auel and J. R. Spurrier. 16,360. July 24th.

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Time-Limit Electric Circuit Controllers. E. A. Carolan. (The General Electric Co., United States.) 16,740. July 30th.

Electric Arc Lamps. E. A. Carolan. (The General Electric Co., United States.) 16,741. July 30th.

Controlling Electric Switches and Cut-Outs. E. A. Carolan. (The General Electric Co., United States.) 16,744. July 30th.

Transformer for Wireless Telegraph Stations. E. Ducretet. 17,034. August 5th.

Electrical Fire Alarm Apparatus. J. P. Robertson. 16,965. August 4th.

Electric Arc Lamps. T. Hamilton-Adams. 17,078. August 5th.

Electric Railway Systems. H. H. Lake. (Morgan Electric Machine Co., United States.) 17,179. August 7th.

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Thermal Cut-Outs. E. A. Carolan. (The General Electric Co., United States.) 18,250. August 24th.

Time-Limit Controllers for Circuit-Breakers. E. A. Carolan. (The General Electric Co., United States.) 18,256. August 24th.

Electric Incandescent Lamp. G. Wallace. 18,318. August 25th.

Electro-Magnetic Rail Brakes. C. A. Wilde. 18,354. August 25th.

Apparatus for Controlling Electric Motors. O. Imray. (Bullock Electric Manufacturing Co., United States.) 18,536. August 27th.

Commutator for Dynamo and Electric Motors. J. MacLean. 18,550. August 28th.